Stockpile Stewardship

Program Mission

The Stockpile Stewardship Program is responsible for providing the capabilities to maintain high confidence in the nuclear stockpile. The maintenance of the research and development (R&D) infrastructure, which includes not only the physical complex of the three weapons laboratories and the Nevada Test Site, but also the scientists and engineers and the basic and applied research base on which the vitality and technical capabilities of the laboratories and the Nevada Test Site rest, is essential to success. The success of the Stockpile Stewardship Program is dependent upon Defense Programs' ability to maintain the level of scientific based capability needed to provide the ongoing technology and science resources required to insure that any Department question can be addressed by the best scientists and engineers using the most advanced sciences and technologies. This capability is of primary importance for the nuclear weapons stockpile responsibilities of the Department, but also supports the needs of other users of the laboratories and the Nevada Test Site by maintaining basic capabilities.

Weapons Stockpile Stewardship provides upgraded or new experimental, computational, and simulation tools needed to address issues of maintaining confidence in the safety, security, and reliability of the nuclear stockpile without underground nuclear testing. The cornerstone of the experimental capabilities provided by the Stockpile Stewardship Program is the National Ignition Facility (NIF) which is currently under construction at the Lawrence Livermore National Laboratory. NIF will provide the means to experimentally study primary boosting, assess secondary performance and weapons effects, and improve and validate new physics models and codes. The Dual Axis Radiographic Hydrodynamic Test (DARHT) facility, currently under construction at the Los Alamos National Laboratory will be the Nation's most advanced hydrodynamic experimental facility; DARHT experiments are essential for validating the implosion performance of primaries. Computational modeling and predictive simulation are integral to every activity in the Stockpile Stewardship and Management Program. Advanced computational and simulation capabilities being developed under the Accelerated Strategic Computing Initiative (ASCI) will be incorporated into ongoing stockpile computational activities. The program also includes research and development to provide the technology required for stockpile management. Key to the success of this science-based program is ensuring that highly qualified people are available for national security programs. At the most fundamental level, the Stockpile Stewardship Program relies on the judgment and skills of experienced scientists and engineers, supported by essential experimental and computational resources, and the preservation of their knowledge base.

Program Goals

- Provide high confidence in the safety, security, reliability and performance of the enduring U.S. nuclear stockpile, without underground nuclear testing, to ensure the effectiveness of the U.S. nuclear deterrent while simultaneously supporting U.S. arms control and nonproliferation objectives.
- Provide the ability to resume U.S. underground nuclear testing and reconstitute nuclear weapons production capacities, consistent with Presidential directives and the Nuclear Posture Review.

Program Objectives

There are four national security objectives in the DOE Strategic Plan upon which this program and budget are based:

Maintain confidence in the safety, reliability, and performance of the nuclear weapons stockpile without underground nuclear testing.

Replace nuclear testing with a science-based Stockpile Stewardship Program.

Ensure the vitality of DOE's national security enterprise.

Reduce nuclear weapons stockpiles and the proliferation threat caused by the possible diversion of nuclear materials.

Strategies

Weapons Stockpile Stewardship supports the following strategies:

Extend the life of U. S. nuclear weapons by continuing the Stockpile Life Extension Program and Stockpile Maintenance activities.

Improve detection and prediction capabilities for assessing nuclear weapon component performance and the effects of aging.

Continually evaluate the safety, reliability, and performance of the nuclear weapons stockpile.

Develop the advanced simulation and modeling technologies and computational tools necessary to confidently mitigate the loss of underground nuclear testing.

Develop new nuclear weapons physics experimental test capabilities.

Advance our understanding of the fundamental characteristics of weapons behavior through weapon systems engineering and advanced experiments to support future assessments of weapons safety, reliability, and performance.

Provide an appropriately-sized, cost-effective, safe, secure, and environmentally sound national security enterprise.

Ensure that sufficient scientific and technical personnel are available to meet DOE's long-term national security requirements.

Ensure and enhance protection of nuclear materials, sensitive information, and facilities.

Maintain test readiness and maintain and enhance emergency response and management capabilities to address any nuclear weapons, radiological or other emergency in the U.S. or abroad.

Dismantle nuclear warheads that have been removed from the U.S. nuclear weapons stockpile in a safe and secure manner.

Performance Measures

For **FY 2000**, the Stockpile Stewardship Program will support the following performance measures:

Meet all annual weapon alteration, modification, and surveillance schedules developed jointly by DOE and DoD.

Conduct studies and development work required to support weapons systems and components for the future stockpile.

Annually report to the President on the need or lack of need to resume underground nuclear testing to certify the safety and reliability of the nuclear weapons stockpile.

Revalidate enduring stockpile systems to meet established military characteristics.

Provide the computer platforms sized to support the stewardship objective of full physics, high fidelity simulations of nuclear weapons performance.

Deliver three-dimensional high fidelity weapons performance codes by 2004.

Demonstrate a computer code capable of performing a three-dimensional analysis of the dynamic behavior of a nuclear weapon primary, including a prediction of the total explosive yield, on an Accelerated Strategic Computing Initiative (ASCI) computer system.

Develop and implement visualization, networking and data management systems to efficiently support utilization of ASCI codes and computers across the weapons complex.

Continue construction of the National Ignition Facility (NIF) according to its Project Execution Plan schedules.

Meet all cost and schedule goals for construction of the Dual-Axis Radiographic Hydrodynamic Test (DARHT) Facility consistent with an FY 2002 completion.

Meet all cost and schedule goals for construction of the Contained Firing Facility at LLNL consistent with a fourth quarter FY 2001 completion.

Meet all cost and schedule goals for construction of the Atlas facility at LANL consistent with a first quarter FY 2001 completion.

Obtain and assess information required to decide whether to construct 1) an advanced hydrotest facility and/or 2) an advanced pulsed power facility.

Conduct two subcritical experiments at the Nevada Test Site to provide valuable scientific information about the behavior of nuclear materials during the implosion phase of a nuclear weapon.

Conduct experimental and theoretical research necessary to maintain or advance research, development, and engineering capabilities in nuclear materials science and weapons design.

Conduct high energy density research on inertial confinement fusion facilities necessary to enhance understanding of areas of physics relevant to a better predictive assessment of nuclear weapons performance.

Ensure that all facilities required for successful achievement of the Stockpile Stewardship Plan are operational.

Ensure that the capability to resume underground nuclear testing is maintained, in accordance with Presidential Decision Directive and Safeguard C of the Comprehensive Test Ban Treaty (CTBT).

Establish strategic alliances and collaborations among the weapons laboratories, industries, and universities to enable effective use of scientific and technical personnel throughout the R&D community.

For **FY 1999**, the Stockpile Stewardship Program, as funded by the FY 1999 appropriation, will support the following significant overall performance measures:

- Annually report to the President on the need or lack of need to resume underground nuclear testing to certify the safety and reliability of the nuclear weapons stockpile. (Secretary of Energy Bill Richardson certified to the President that the nuclear stockpile is safe, secure, and reliable on December 22, 1998.)
- Meet all DoD annual weapons alteration, modification, and surveillance schedules.
- Continue revalidation of the military characteristics of the W76 warhead, and begin revalidation of a second weapon type.
- Accelerate the ongoing development of critical, full-physics, three-dimensional weapons simulation codes; specifically, perform sustained weapons simulations at 1 trillion operations per second.
- Demonstrate operation of a 10 trillion operations per second computer system.
- Deliver a computer code capable of performing a three-dimensional analysis of the dynamic behavior of a nuclear weapon primary, including a prediction of the total explosive yield, on an ASCI computer system. Compare computed results with existing nuclear test data.
- Meet all cost and schedule goals for construction of NIF and related technology development, including completion of the Optics Assembly Building, initiation of Special Equipment installation, and completion of the Target Bay Area for Target Chamber installation.
- Begin operations of the first accelerator of DARHT and deliver accelerator cells for prototype testing with the beam for the second accelerator.
- Make the decision within the 5-year period whether to construct an advanced hydrotest facility and/or an advanced pulsed power facility.
- Conduct two to three subcritical experiments at the Nevada Test Site to provide valuable scientific information about the behavior of nuclear materials during the implosion phase of a nuclear weapon.
- Establish strategic alliances and collaborations among the weapons laboratories, industries, and universities to enable effective use of scientific and technical personnel throughout the R&D community.
- Maintain the capability to resume underground testing, in accordance with Presidential direction.

Significant Accomplishments and Program Shifts

During **FY 1998**, implementation of the Stockpile Stewardship Program, initiated in FY 1994, continued in accordance with the Stockpile Stewardship and Management Plan and resulted in the following accomplishments:

- Successfully completed certification of the safety and reliability of the U.S. nuclear weapons stockpile according to DOE/DoD procedures.
- President Clinton announced and endorsed ASCI's Pathforward initiative contract awards at a LANL press conference on February 3, 1998. Awardees of the $50 million 4-year contracts aspire to achieve a 30Tf supercomputer performance by the year 2001.

DOE announced on February 12, 1998, selection of IBM for the ASCI Option White (10Tf) supercomputer to be located at LLNL.

Vice President Gore and Energy Secretary Bill Richardson announced on October 28, 1998, the world's fastest computer at LLNL. The ASCI Blue Pacific - SST IBM machine, which contains 2.6 trillion bytes of memory, and will perform 3.9 trillion operations per second.

Measured a fundamental property of hydrogen (equation of state) in the Nova laser at weapon-relevant pressures providing unexpected results that change our understanding of weapon performance and the state of hydrogen within the planet Jupiter. This work was awarded the American Physical Society's prize for the Outstanding Plasma Physics Accomplishment for 1998.

Completed flight tests and laboratory tests which support stockpile surveillance activities, including flight tests to support the final certification of the B61-11.

Completed modeling of applicable past nuclear tests and hydro tests for certification rationale to support the SLBM Warhead Protection Program.

Continued development activities for, or refurbishment of, eight weapons alterations and/or modifications, including B61, W87, B83, and W76 alts, and the B83 mod.

Successfully conducted the third and fourth subcritical experiments, "Stagecoach" and "Bagpipe," which provided data to improve the accuracy of computer simulations of nuclear weapons as part of the science-based Stockpile Stewardship Program, and were used to develop and refine diagnostics for the more complex subcritical experiments of the future**.**

Maintained the capability to resume underground nuclear testing in accordance with the Presidential Decision Directive and Safeguard C of the CTBT through a combined experimental and test readiness program that included 29 high-explosive experiments at the Nevada Test Site and hundreds of stockpile stewardship experiments conducted at various facilities which exercise many nuclear testing related skills and technologies, including nuclear design, experiment integrations, nuclear chemistry, and weapons engineering. Conducted a table-top exercise that simulated a mass venting of an underground nuclear test at the NTS, exercising the emergency response systems that could be needed during a nuclear test. Continued an ongoing archiving program designed to preserve the knowledge and testing experience of departing personnel as well as data, photos, drawings, procedures, nuclear explosive safety studies, containment evaluation plans, lessons learned, and other information.

Developed and used proton radiography to examine high explosive detonation issues related to typical weapons in the U.S. stockpile which allows designers to assess high explosive performance over a large temperature range and to develop computational models used for stockpile assessment and certification.

Using neutron resonance spectroscopy, obtained the first simultaneous measurements of the internal temperature and average velocity of atoms in a shocked metal which will underpin detailed models of the hydrodynamics of weapon materials.

Created a new encapsulant for nuclear weapon components with much higher resistance to high voltage breakdown which will improve the reliability of miniature high voltage firing sets.

Developed ion-implantation process which has doubled the strength of electroformed nickel alloys for nuclear weapon miniature electromechanical devices such as strong-link switches and gyroscopes.

- Completed facility construction of the first arm of DARHT at the Los Alamos National Laboratory and began the preliminary design of the second axis accelerator for DARHT.
- Began the physical construction of NIF on schedule and maintained schedule throughout the year despite the impacts of El Niño rains.

Program Shifts

In FY 2000, the first steps will be taken to integrate the advanced computational and simulation models, methodologies, and materials models developed and matured within the Accelerated Strategic Computing Initiative with various relevant and complementary components of ongoing Core Stewardship activities. These integrated activities are key elements of the model and simulation-based capabilities needed to maintain the Nation's nuclear weapon stockpile. Advancements in systems modeling will be incorporated into the ongoing technical reviews of stockpile weapons conducted in support of the annual certification process. Materials models and databases will be utilized to address weapons aging and reliability issues and to support the reliability and surety of remanufactured components. Verified and validated primary and secondary codes will be used to support the surveillance, assessment and refurbishment of the weapons systems in the nuclear weapons stockpile. **Integration of achievements from Accelerated Strategic Computing Initiative (ASCI) with the ongoing Core Stewardship program** is essential to provide high confidence in the safety, security, reliability and performance of the enduring U.S. nuclear stockpile, without underground nuclear testing.

The Stockpile Stewardship Program plans to invest in an **infrastructure construction initiative** at the three laboratories and the Nevada Test Site. Over a 5 - 10 year period, the goal is to invest approximately $100 million per year to maintain and refurbish aging infrastructure systems and facilities. The funding planned for the initiative will support ongoing and new infrastructure construction projects, but does not include the funding for programmatic construction projects.

The funding responsibility for the **Los Alamos County School District** subsidy and the **Northern New Mexico Education Enrichment Foundation** have been transferred to the Education program from the Weapons Program Direction budget. Funding for the **National Atomic Museum**, to be located at the International Balloon Park Museum in northern Albuquerque, New Mexico is also included in the Education program.

Defense Programs is studying the replacement of the current Administration Building complex (SM-43) at Los Alamos National Laboratory. This complex serves both administrative and technical divisions, including weapon assessment and certification groups. The complex is 45 years old and increasingly difficult and costly to maintain. All building systems have exceeded their design life. The Department is facing expensive upgrades to the electrical and fire protection systems, as well as major seismic upgrades.

Site-Wide Environmental Documentation

Defense Programs oversees and coordinates site-wide environmental documentation activities at the three weapons laboratories and the Nevada Test Site, as the Department's landlord, although funding is provided by all affected activities at each site. The Record of Decision on the Nevada Test Site site-wide environmental impact statement (SWEIS) was completed in December 1996. The Los Alamos National Laboratory SWEIS is expected to be completed by the end of the second quarter of FY 1999. The Sandia National Laboratories (New Mexico) SWEIS has begun, with a Notice of Intent completed in May of 1997. The draft SWEIS is scheduled for distribution for comment in the second quarter of FY 1999, with completion of the SWEIS anticipated by the end of FY 2000. Defense Programs is also conducting a 5-year review or supplement analysis of the Lawrence Livermore National Laboratory SWEIS, originally completed in 1992; a determination on this supplement analysis is expected in the second quarter of FY 1999. The Stockpile Stewardship and Management programmatic environmental impact statement (PEIS), the basis of the FY 1997 Record of Decision for Defense Programs, supports major projects including NIF. Defense Programs is preparing a supplemental EIS for the National Ignition Facility to review the environmental impacts of additional information discovered since the Stockpile Stewardship and Management PEIS was completed.

Management and funding responsibility for several production related facilities at LANL, including the Plutonium Facility (Technical Area 55), the Chemistry and Materials Research Laboratory, and the Los Alamos Criticality Experiments Facility, was transferred to the Weapons Stockpile Management decision unit in FY 1998.

Conceptual Design Reports and Post-Conceptual Design Engineering

During the budget request period, FY 1999-FY 2001, Defense Programs may choose to begin conceptual design activities for an advanced hydrotest facility and an advanced pulsed power facility. It is estimated that each of these conceptual design reports will likely cost in excess of $3 million.

Budget Structure

The Weapons Stockpile Stewardship budget request is organized in the following manner:

- **Core Stockpile Stewardship**: This program supports the specific activities required for science-based Stockpile Stewardship through the maintenance of the physical and intellectual infrastructure at Lawrence Livermore National Laboratory, Los Alamos National Laboratory, Sandia National Laboratories and the Nevada Test Site. Major program elements include Programs and Initiatives, Core Research and Advanced Technology, and Testing Capabilities and Readiness. The budget structure for Core Stockpile Stewardship is more "functional" than "programmatic." Because there is such a large research and development aspect to Stockpile Stewardship, in many cases, the basic capabilities that we must maintain across the laboratories and plants serve many programmatic objectives. While they are not "functional" in the same sense as the Department's Functional Cost Reporting structure which focuses on indirect activities, they are inputs, rather than outputs, for the laboratories.
- **Inertial Confinement Fusion**: The Inertial Confinement Fusion program is a research and advanced technology development effort directly supporting the Department's national security mission in Stockpile Stewardship. The National Ignition Facility (96-D-111), a 192-beam neodymium glass laser facility intended to achieve controlled thermonuclear fusion in the laboratory, is under construction at LLNL. When completed, the NIF will be a cornerstone of the Stockpile Stewardship program, and represents a major initiative for the Department.
- **Technology Partnerships and Education**: The Technology Partnerships and Education programs directly share the expertise and scientific development in the laboratories with the private sector and obtain skills and knowledge from the private sector for the enhancement of laboratory capabilities. The Technology Partnerships program strengthens the science and technology base through participation in cooperative, dual-benefit partnerships with private industry. Education initiatives support science education activities and enhance continuing technical capabilities in support of the program's mission, exercising the unique capabilities of the Department of Energy with emphasis on graduate and post-graduate activities.

Funding Profile

(dollars in thousands)

	FY 1998 Current Appropriation	FY 1999 Original Appropriation	FY 1999 Adjustments	FY 1999 Current Appropriation	FY 2000 Request
Stockpile Stewardship					
Core Stockpile Stewardship					
Operations & Maintenance .	1,281,104	1,482,632	-29,330	1,453,302	1,635,355
Construction	98,810	103,443	3,683	107,126	133,145
Total, Core Stockpile Stewardship	1,379,914	1,586,075	-25,647	1,560,428	1,768,500
Inertial Confinement Fusion					
Operations & Maintenance .	215,654	223,800	-4,618	219,182	217,600
Construction	197,800	284,200	0	284,200	248,100
Total, Inertial Confinement Fusion	413,454	508,000	-4,618	503,382	465,700
Technology Partnerships & Education					
Technology Partnerships . .	55,901	45,000	-1,928	43,072	22,200
Education	8,944	9,000	0	9,000	29,800
Total, Technology Partnerships & Education	64,845	54,000	-1,928	52,072	52,000
Subtotal, Stockpile Stewardship	1,858,213	2,148,075	-32,193	2,115,882	2,286,200
Use of prior year balances .	-454[a]	-39,552[b]	32,193[cd]	-7,359	0
Total, Stockpile Stewardship .	1,857,759	2,108,523	0	2,108,523	2,286,200

Public Law Authorization:

Public Law 105-85, National Defense Authorization Act for FY 1998.

[a] Reflects Stockpile Stewardship allocation of appropriated use of prior year balances: Core Stewardship $ -359,000; ICF $ -52,000; and Technology Partnerships $ -43,000.

[b] Reflects Stockpile Stewardship allocation of appropriated use of prior year balances: $ -39,552,000.

[c] Reflects Stockpile Stewardship allocation of appropriated use of prior year balances, taken as reductions to new budget authority: Core Stewardship $ -33,006,000; ICF $ -4,618,000; and Technology Partnerships $-1,928,000, and reapplication of available prior year balances to cover FY 1999 program activities: Core Stewardship $ +3,676,000.

[d] Reflects reprogramming of $3,683,000 (98-R-4), approved November 1998.

Discussion of Activities

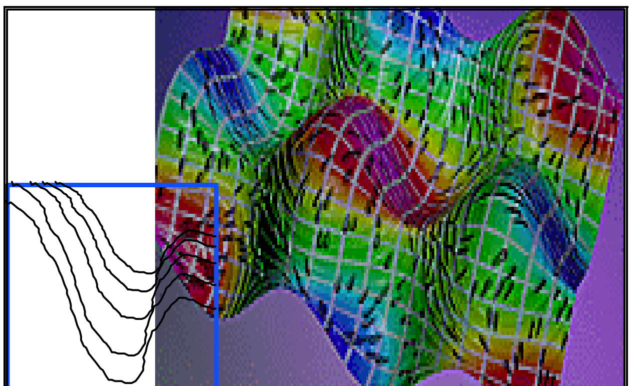
The Stockpile Stewardship activities provide the physical and intellectual infrastructure at the weapons laboratories and the Nevada Test Site, and provides the scientific, engineering, and computational tools needed to address issues of maintaining confidence in the safety, reliability and performance of the nuclear weapons stockpile without underground nuclear testing. The Stockpile Stewardship decision unit consists of the Core Stockpile Stewardship, Inertial Confinement Fusion, Technology Partnerships, and the Education programs.

The FY 2000 budget for the Stockpile Stewardship program has been formulated to balance the need to develop and maintain essential scientific and technical capabilities over the long term with near-term workload requirements and schedules. This has required difficult, but appropriate, choices that have resulted in some reduction of opportunities to improve our understanding of the hydrodynamic behavior of primaries, develop physics and materials models, and take full advantage of the National Ignition Facility for weapons physics experiments.

Core Stockpile Stewardship

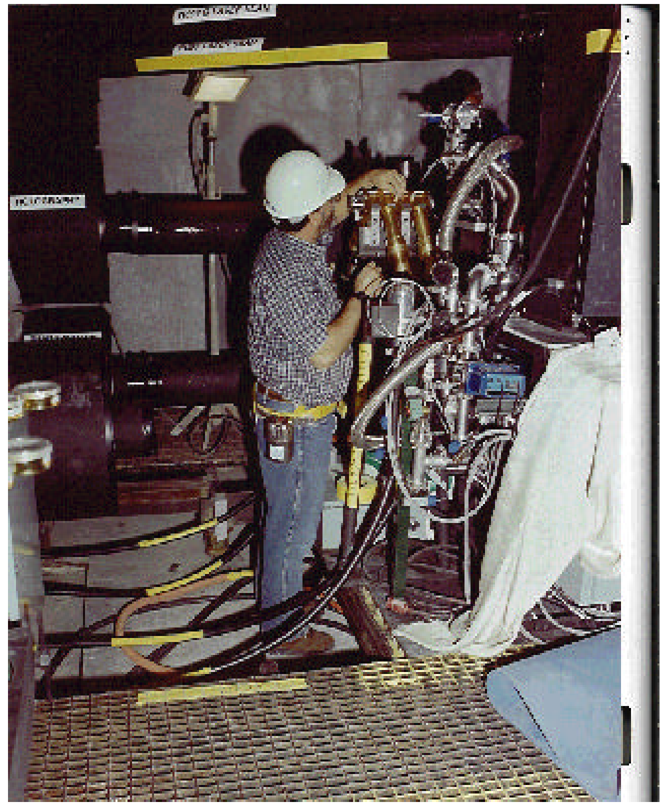
The FY 2000 request of $1,768.5 million for Core Stockpile Stewardship maintains a capable physical and intellectual infrastructure to support the enduring stockpile, including surveillance, evaluation, and preventive maintenance for the stockpile; provides and enhances the research, engineering and development capabilities, including advanced computing and experimental simulation and modeling, required to refurbish and recertify the enduring stockpile; maintains the capability to resume underground nuclear testing, if directed; and retains the ability to develop and support the manufacturing of replacement designs.

Direct Stockpile Activities includes studies and research to apply basic science to surveillance, assessment, and refurbishment requirements associated with the **nuclear weapons stockpile**, as defined by Department of Energy commitments to the DoD and Stockpile Management requirements. Included are Enhanced Fidelity Instrumentation, ACORN Implementation, the Submarine Launched Ballistic Missile Warhead Protection Program, and Stockpile Readiness/Safety Assessments. The Stockpile Life Extension Programs (SLEP) will provide Full Scale Engineering Development (FSED) and other required phase 6.2A and 6.3 activities for the W76 and W80, including support for the refurbishment First Production Unit (FPU) date of FY 2005 for the W76 and FY 2006 for the W80. Verified and validated primary and secondary code simulations and models will be used to support the surveillance, assessment and refurbishment of the weapons systems in the nuclear weapons stockpile.



Transitioning from 2-D to 3-D simulation codes will help to better predict many aspects of the aging stockpile.

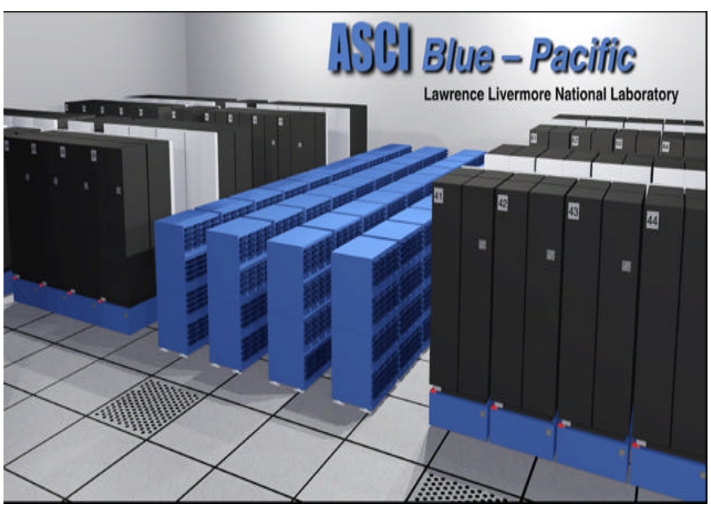
Experimental Activities provides the ability to certify the enduring stockpile in the absence of nuclear testing, and improves our understanding of stockpile aging and the effects of reliability through experiments using high explosives and/or small quantities of special nuclear material. In FY 2000, two **subcritical experiments** will be conducted at the Nevada Test Site. Subcritical experiments are scientific experiments using chemical high explosives to generate high pressures which are applied to nuclear materials. High speed measurement instruments are used to obtain valuable scientific data on the behavior of those nuclear materials under conditions similar to those during the implosion phase of a nuclear weapon. The configuration and quantities of explosives and nuclear materials are designed so that no nuclear explosion will take place. The data obtained from subcritical experiments will help benchmark complex computer simulations of nuclear weapons performance and will be used to help certify the safety and reliability of the Nation's nuclear weapons stockpile. With the moratorium on underground nuclear testing, scientists and engineers compare experimental data with data from prior underground nuclear tests in order to validate or modify computational codes.



Cimarron subcritical experiment conducted in Nevada on December 11, 1998.

Experiments will also be conducted at the **Los Alamos Neutron Science Center (LANSCE)** in advanced materials science, nuclear science and particle-beam accelerator technology in addition to weapons surveillance. The **Z Pulse Power Program**, which is funded through both the ICF and Core Stewardship programs, is supported at a constrained level sufficient to pursue only highest priority activities.

Also within Core Stockpile Stewardship, the **Accelerated Strategic Computing Initiative (ASCI)** is on track to attain 100 trillion operations per second (TeraOps) level by 2004, building upon the successes achieved with the demonstrated 1 TeraOp on the Option Red computer and the recently demonstrated performance of the Option Blue computer platforms at LLNL and LANL. The Option White computer is planned to perform at a peak level of 10 TeraOps in year 2000 through a sequence of technology updates. Also during FY 2000, ASCI will continue building “more complete physics” 3-D computer codes which, in conjunction with the experimental programs in core stewardship and ICF, are aimed at providing the required levels of fidelity in weapons simulations.



Stockpile Computing provides the traditional core computing capabilities in the weapons complex as well as implementation of the **Numerical Environment for Weapons Simulations**, (NEWS). Launched in FY 1999, NEWS will create localized data exploration super corridors to support large-scale data analysis and assimilation tasks for researchers and weapons assessment teams.

Construction is continued on two new experimental facilities: the **Dual Axis Radiographic Hydrodynamic Test (DARHT) Facility** and the **Atlas pulsed power facility**, both at Los Alamos National Laboratory. DARHT's dual-axis, multi-time viewing capability will replace LANL's current diagnostic tool for hydrodynamic testing, the Pulsed High-Energy Radiographic Machine Emitting X-Rays, and provide crucial experimental data on many of the stockpile systems. Atlas will provide a pulsed power experimental capability to address secondary weapons physics questions in a high energy density environment.

Advanced hydrodynamic radiography development activities are supported, leading to a decision within the planning period whether to construct an advanced hydrodynamic radiography facility. Startup costs and a limited number of experiments on the Two Stage **Gas Gun** and the **Big Explosive Experimental Facility (BEEF)** at the Nevada Test Site are provided along with other experimentation and research radiation flow, cross sections, hydrodynamics, equation of state, etc, needed for advanced computer modeling and analyses, in lieu of underground nuclear testing.

Ongoing **Core Research and Advanced Technology** activities including physics; systems engineering; advanced manufacturing; chemistry and materials, high explosives, special nuclear materials, and tritium research will continue. Systems modeling and materials models and databases developed and matured in ASCI will be incorporated into these research areas.

Testing Capabilities and Readiness to resume underground nuclear testing within 2-3 years is maintained. Support is provided for the University of Nevada Cooperative Agreement which was initiated in FY 1998 to encourage and facilitate collaborative efforts between academic researchers at Nevada institutions of higher education and researchers at the national laboratories and other DOE contractors.

Funding is also included in Stockpile Stewardship's **infrastructure construction** account to initiate three new construction projects which will provide the unique floor space needed at the laboratories to house the state of the art computers as well as provide visualization and other capabilities to maximize the utility of the greatly enhanced computing capabilities by the weapon designers. The **Strategic Computing Complex** at LANL and the **Terascale Simulation Facility** at LLNL will provide clear unobstructed computer floor space with scalable power and cooling capabilities to house 100 TeraOps and beyond. The **Joint Computational Engineering Laboratory** at SNL will provide a state-of-the-art facility for research, development, and application of leading edge, high-end computational and communications technologies.

Inertial Confinement Fusion (ICF)

The request of $465.7 million for the ICF program supports a minimal indirect drive program and introduces some risk to the **National Ignition Facility (NIF)** research program. The request provides the required construction funding to maintain the project on schedule; however, the schedule for the ignition program on NIF will be at risk. Specifically, the funds will support NIF infrastructure buildup, operational training and initiation of laser area operations; NIF optics pilot production, NIF component validation; and,

The target bay floor slab with additional forms in place durin the second week of November.

experiments and computational theory and modeling consistent with potentially delayed NIF ignition plan. The ICF program will provide the required capabilities for only the highest priority weapons program led experiments on Omega, and possibly, Nike. Funding for the NIF cryogenic handling system is not included in the request, deferring the initiation of this effort until FY 2001. The request supports the direct drive ignition program, based on the ignition plan, at Omega and the Nike facility at the Naval Research Laboratory. The Z program, which is funded through both the ICF and Core Stewardship programs, is supported at a level sufficient to pursue the highest priority activities. The request provides for the minimal level of target deliveries from General Atomics to the ICF laboratories, but does not include funding for any cryogenic research. Finally, support is provided for the grants program to independent investigators in high energy density physics directly related to stockpile stewardship.

Technology Partnerships

The FY 2000 request of $22.2 million supports, at a significantly reduced level, ongoing industrial partnerships focused on advanced manufacturing and the development of current and potential key suppliers of components, software, hardware, and equipment for the Weapons Stockpile Stewardship Program. In addition, funding is provided for the Amarillo Plutonium Research Center, the Advanced Computational Technology Initiative (ACTI), and the Small Business Program.

Education

The FY 2000 request of $29.8 million for the Education program provides funding for utilization of the unique resources of the Department of Energy national laboratories—people, programs, and facilities—to improve science and math education throughout the Nation. Enhancing the scientific education of our citizens will ensure a highly trained, diverse scientific workforce for the laboratories and will enhance our ability to conduct the Stockpile Stewardship mission. The projects, approved by Headquarters and conducted by the national laboratories, are grouped in six major categories: teacher/faculty enhancement, curriculum improvement, institutional improvement, student support, educational technology and public understanding of science. Each laboratory publishes an annual report on the projects and their accomplishments. Historically Black Colleges and Universities and other minority institutions receive approximately 15 percent of this funding.

Support for the Los Alamos County School District and the New Mexico Educational Enrichment Foundation, formerly funded under Weapons Program Direction, is included in the Stockpile Stewardship funding beginning this fiscal year. Funding is also requested for the National Atomic Museum to be built in Albuquerque, New Mexico.

Explanation of Funding Changes from FY 1999 to FY 2000

Stockpile Stewardship is requesting $2,286.2 million in FY 2000, an increase of $170.3 million, or 8 percent above the FY 1999 appropriation of $2,115.9 million. The funding increase, primarily in Core Stewardship, is needed to verify, validate, and integrate the simulation and modeling advances, developed and matured in ASCI, into the ongoing research and development program, which maintains the current nuclear weapon stockpile and supports the annual certification process. The integration of these simulation and modeling advances with the ongoing modeling efforts in materials science, hydrodynamics, and radiation flow is essential to achieving the weapons performance and safety code objectives required for stockpile assessment and certification without underground nuclear testing. The increase in funding also supports continued growth in the ASCI and Stockpile Computing programs; continuation of ongoing construction projects, initiation of three new infrastructure projects; the transfer of funding to support the

Los Alamos County School District and the Northern New Mexico Educational Enrichment Foundation from the Weapons Program Direction account; and the initiation of the National Atomic Museum at Albuquerque, New Mexico. These increases are partially offset by decreases to Technology Partnerships and NIF construction funding.

The budget request for the **Core Stockpile Stewardship** program is $1,768.5 million, an increase of $208.1 million, or 13 percent, over the FY 1999 adjusted appropriation. Additional information can be found in the Detailed Program Justification; however, significant funding changes include:

+ $ 37.6 million	Increase to **Direct Stockpile Activities** to support development activities to support refurbishment of the W76 Trident SLEP, and primary and secondary code verification and validation for stockpile weapon systems.
+ $ 4.5 million	Increase to **Experimental Activities** to support archiving and experimental activities, including complex subcritical experiments, in support of stockpile certification efforts.
+ $ 40.1 million	Continue planned growth in the **Accelerated Strategic Computing Initiative**, including support for accelerated 3-D code development, planned platform requirements, academic alliances, and accelerated distributive and distance computing.
- $ 8.7 million	Decrease to **Special Projects** reflecting the transfer of waste management activities to the waste generators.
+ $ 59.5 million	Increase to **Performance Assessment Science & Technology** to support additional hydrotest experiments, neutron science research at LANSCE, advanced hydrodynamics research, and verification and validation of systems modeling in support of annual stockpile certification.
+ $ 43.8 million	Increase to **Chemistry & Materials Science & Technology**, including verification and validation of materials modeling to address weapons aging and reliability issues and to support the reliability and surety of remanufactured components.
+ $ 18.7 million	Increase to **Stockpile Computing**, including continuation of the Numeric Environment for Weapons Simulation initiative which will create data exploration supercorridors to support large-scale data analysis by researchers and weapons assessment teams.
- $ 13.4 million	Reduction to **Testing Capabilities and Readiness** funding to support two subcritical experiments, a decrease from the FY 1999 funding level which supported three to four experiments.
+ $ 26.0 million	Initiate three new infrastructure projects: **Strategic Computing Complex** at LANL, **Terascale Simulation Facility** at LLNL, and **Joint Computational Engineering Laboratory** at SNL; continue funding for construction of **DARHT**; partially offset by decreases in funding requirements for ongoing Stewardship construction.

The budget request for the Inertial Confinement Fusion program is $465.7 million, a decrease of$37.7 million, or 7 percent, from the FY 1999 appropriation, reflecting the scheduled decrease in NIFconstruction funding and completion of the NIF optics pilot production. The NIF construction scheduleis maintained within this request. Within the program, the National Ignition Plan is partially supported, with minimal development of NIF target diagnostics and experimental equipment, and the initiation of the NIF cryogenic handling system, originally planned for FY 2000, is delayed until FY 2001. Funding is included to utilize Omega for 18 weeks of weapons physics experiments by scientists from LANL and LLNL, the same as the FY 1999 level.

The budget request for Technology Partnerships is $22.2 million, a decrease of $20.9 million, or 48 percent, from the FY 1999 appropriation of $43.1 million. The FY 2000 request includes up to funding for the Amarillo Plutonium Research Center and up to $9 million for ACTI. The remaining $8.2 million will support ongoing R&D Cooperative Agreements. Some partnerships will begin transition to closeout in FY 1999 while others may be absorbed within other core stewardship efforts as appropriate.

The budget request for the Education program is $29.8 million, an increase of $20.8 million, associated with the transfer of funding responsibility from the Weapons Program Direction budget for the Los Alamos County School District (up to $8.0 million) and the Northern New Mexico Education Enrichment Foundation (a minimum of $6.0 million), support for the new National Atomic Museum ($5.5 million) to be built in northern Albuquerque, New Mexico, and an increase of $1.3 million to other Education activities.

Funding by Site

(dollars in thousands)

	FY 1998	FY 1999	FY 2000	$ Change	% Change
Albuquerque Operations Office					
Albuquerque Operations Office	0	2,834	14,000	+11,166	+394.0%
Kansas City Plant	3,855	1,750	500	-1,250	-71.4%
Pantex Plant	0	388	388	0	0%
Los Alamos National Laboratory	451,727	522,429	589,790	+67,361	+12.9%
Sandia National Laboratories	453,887	499,436	521,389	+21,953	+4.4%
Total, Albuquerque Operations Office	909,469	1,026,837	1,126,067	+99,230	+9.7%
Chicago Operations Office					
Argonne Nat'l Lab	1,900	1,250	0	-1,250	-100.0%
Nevada Operations Office	183,644	199,264	198,106	-1,158	-0.6%
Oak Ridge Operations Office					
Oak Ridge Y-12	11,550	6,860	5,740	-1,120	-16.3%
OR Science & Technology Institute . .	149	147	150	+3	+2.0%
Oak Ridge National Laboratory	908	954	1,518	+564	+59.1%
Total, Oak Ridge Operations Office	12,607	7,961	7,408	-553	-6.9%
Oakland Operations Office					
General Atomics	10,937	8,870	7,000	-1,870	-21.1%
Lawrence Berkeley Nat' l Laboratory .	6,374	15,112	23,018	+7,906	+52.3%
Lawrence Livermore Nat'l. Laboratory	690,183	760,061	806,336	+46,275	+6.1%
Naval Research Laboratory	9,000	16,758	9,500	-7,258	-43.3%
Oakland Operations Office	3,920	7,937	7,200	-737	-9.3%
University of Rochester	26,349	28,850	30,500	+1,650	+5.7%
Total, Oakland Operations Office	746,763	837,588	883,554	+45,966	+5.5%
Savannah River Operations Office					
Savannah River Westinghouse	1,515	1,907	1,900	-7	-0.4%
Headquarters	2,315	41,075	69,165	+28,090	+68.4%
Subtotal, Stockpile Stewardship	1,858,213	2,115,882	2,286,200	+170,318	+8.0%
Use of prior year balances	-454[a]	-7,359[b]	0	+7,359	-100.0%
Total, Stockpile Stewardship	1,857,759	2,108,523	2,286,200	+177,677	+8.4%

[a] Reflects Stockpile Stewardship allocation of appropriated use of prior year balances: Core Stewardship $ -359,000; ICF $ -52,000; and Technology Partnerships $ -43,000.

[b] Reflects reapplication of available prior year balances to cover FY 1999 program activities: Core Stewardship $ +3,676,000; and a reprogramming of $3,683,000 (98-R-4), approved November 1998.

Site Description

Weapons Stockpile Stewardship activities are conducted predominantly at the three weapons laboratories, Lawrence Livermore, Los Alamos, and Sandia National Laboratories in California and New Mexico, and at the Nevada Test Site. Funding is also provided to the University of Rochester, the Naval Research Laboratory, and General Atomics through the Inertial Confinement Fusion program and to various production sites for research and development activities related to Stockpile Stewardship. Other miscellaneous locations are funded through the Stockpile Stewardship program as noted on the Funding by Site table above.

Los Alamos National Laboratory

The Los Alamos National Laboratory (LANL), established as a nuclear weapons design laboratory in 1943, is located on about 28,000 acres adjacent to the town of Los Alamos, New Mexico, which is approximately 25 miles northwest of Santa Fe.

The core competencies at LANL supporting the Stockpile Stewardship Program include theory, modeling and simulation, and high-performance computing to model a broad range of physical, chemical, and biological processes; complex experiments and measurements; nuclear and advanced materials; and nuclear weapons science and technology including the physics of nuclear weapons design and large-scale calculations of weapons phenomena. LANL also possesses unique capabilities in neutron scattering required for stockpile stewardship and enhanced surveillance and shares with LLNL the responsibility for the safety and reliability of the physics package in the Nation's nuclear weapons.

Among the major specialized facilities at LANL are the TA-55 Plutonium Facility for surveillance of plutonium "pits" and plutonium pit manufacturing, actinide research, and nuclear waste research and the Los Alamos Neutron Science Center user facility for supporting advanced materials science, nuclear science and particle-beam accelerator technology in addition to weapons surveillance. Two new facilities, the Dual Axis Radiographic Hydrodynamic Test (DARHT) Facility and the Atlas pulsed power facility, are now under construction. DARHT's dual-axis, multi-time viewing capability will replace LANL's current diagnostic tool for hydrodynamic testing, the Pulsed High-Energy Radiographic Machine Emitting X-Rays, and provide crucial experimental data on many of the stockpile systems. Atlas will provide a pulse power experimental capability to address secondary weapons physics questions in a high energy density environment.

Sandia National Laboratories

The Sandia National Laboratories (SNL) are responsible for the nonnuclear components and systems engineering for all nuclear weapons and is a crucial point of contact with DoD in the areas of weapon requirements, system design, logistics, surveillance, training, and dismantlement. SNL manufactures certain nonnuclear components including neutron generators and is capable of providing an assured source of radiation hardened electronics. SNL provides unique capabilities in advanced manufacturing technology, microelectronics, and photonics and maintains distinctive competencies in engineered materials and processes, computational and information sciences, engineering sciences, and pulsed-power technology. Distributed Computing at a Distance, a component of the ASCI program, will originate at SNL.

Among the major specialized facilities at SNL are a Microelectronics Development Laboratory, a Combustion Research Facility for combustion science and laser spectroscopy, an Advanced

Manufacturing Processes Laboratory for rapid prototyping and assessing quality and reliability, an Intelligent Systems and Robotics Center supporting intelligent and agile manufacturing, and Pulsed Power Accelerators for testing and development of defense components.

Nevada Test Site

The Nevada Test Site (NTS), established in 1950, encompasses approximately 867,000 acres in Nye County in southern Nevada, about 65 miles northwest of Las Vegas. Since the U.S. Nuclear Testing Moratorium Act went into effect in early October 1992, no nuclear tests have been conducted by the United States.

The core mission at the NTS is to maintain the capability to conduct an underground nuclear test within 2-3 years of any such request by the President. Maintenance of this capability is required by Presidential Directive and is consistent with the Administration's Safeguards accompanying the Comprehensive Test Ban Treaty. To fulfill this mission, the necessary NTS infrastructure, facilities, and technical personnel are supported through exercises and experiments. Subcritical experiments sponsored by the nuclear weapons design laboratories (LANL and LLNL) serve a dual purpose of providing experimental data and exercising nuclear testing personnel skills; these experiments are the primary basis of maintaining nuclear test readiness.

General Atomics

General Atomics, located in La Jolla, California, is the current contractor for supplying the national laboratories with inertial confinement fusion targets for experimental campaigns.

Lawrence Livermore National Laboratory

The Lawrence Livermore National Laboratory (LLNL), was established as a nuclear weapons design laboratory in 1952. It is located on 1.3 square miles in Livermore, California. It has an auxiliary testing range located on eight square miles situated about 18 miles east of the main site. LLNL's primary mission is to support DOE's Stockpile Stewardship Program to ensure that the nation's nuclear weapons remain safe, secure, and reliable and to prevent the spread and use of nuclear weapons worldwide. The laboratory brings to this mission extensive experience in supercomputing and laser technology as well as a broad range of world-class science and engineering capabilities, including nuclear science and technology and advanced sensors and instrumentation. LLNL has demonstrated successes in assembling multi-disciplinary approaches, applying expertise in advanced defense technologies, energy, environment, biosciences, and basic science, to complex national issues.

Among the major specialized facilities supporting LLNL's programmatic efforts are the ASCI Blue Pacific computer system for high-fidelity weapon simulation, the High Explosive Applications Facility for energetic materials research, the Flash X-Ray Facility for hydrodynamic tests, and the Nova laser which will be used for inertial fusion and weapon-physics research until its scheduled closure in FY 1999.

New projects are underway to prepare LLNL's capabilities for its critical responsibilities to maintain the nuclear deterrent without nuclear testing. The National Ignition Facility (NIF) has been under construction since June 1997 and will be the world's largest and most powerful laser facility when completed in FY 2003. NIF will perform fusion, weapon-physics, and weapon-effects experiments in support of the Stockpile Stewardship Program. An important step toward meeting the DOE's goal of establishing the advanced weapon simulation capability required by the Stockpile Stewardship Program will be the construction of the Terascale Simulation Facility. The Contained Firing Facility is a hydrodynamic test facility that will be an environmental improvement to Livermore's existing Flash X-Ray Facility.

Naval Research Laboratory

The Naval Research Laboratory located in Washington, D.C. contributes to the national Inertial Confinement Fusion program through the use of its Krypton-fluoride Nike laser which was completed in FY 1995. Nike's capabilities are particularly useful for defining beam smoothness requirements for direct drive laser fusion ignition. In addition, the laboratory has strong capabilities in code development and atomic physics.

University of Rochester

The University of Rochester's Laboratory for Laser Energetics in Rochester, New York, operates its 60-beam glass laser, Omega, primarily for research on direct drive laser fusion. However, the Omega facility is increasingly being used to field weapons physics experiments by scientists from Lawrence Livermore National Laboratory and Los Alamos National Laboratory as operation of Nova ceases in FY 1999.   The use of Omega for weapons physics will continue as the stockpile stewardship program transitions to the use of NIF beginning on the first bundle in FY 2002.

Core Stockpile Stewardship

Mission Supporting Goals and Objectives

The Core Stockpile Stewardship Program provides confidence in the safety and reliability of the U.S. nuclear weapons stockpile, and maintains a nuclear design capability for the indefinite future in the absence of new weapons requirements and underground nuclear testing. This program maintains the U.S. capability to resume underground nuclear testing within 2-3 years and provides the physical and intellectual infrastructure, including computational and simulation capabilities, required to meet the programmatic requirements of the science-based Stockpile Stewardship Program without underground nuclear testing. Primary locations of activity are the Lawrence Livermore, Los Alamos and Sandia National Laboratories and the Nevada Test Site. The Stockpile Stewardship Plan provides primary programmatic guidance.

Ongoing Activities

- Maintain and enhance an effective stockpile surveillance and evaluation program, including preventive maintenance for the stockpile;
- Continue to create and deploy leading-edge computational and simulation capabilities;
- Support advanced experimental facilities;
- Provide and enhance the research, development, and engineering capabilities required to refurbish and recertify the safety and reliability of the enduring stockpile; and
- Retain the ability to develop and support the manufacturing of replacement designs.

In FY 2000, the first steps will be taken to integrate the advanced computational and simulation models, methodologies, and materials models developed and matured within the Accelerated Strategic Computing Initiative (ASCI) with various relevant and complementary components of ongoing Core Stewardship activities. These integrated activities are key elements of the model and simulation-based capabilities needed to maintain the Nation's nuclear weapon stockpile. Advancements in systems modeling will be incorporated into the ongoing technical reviews of stockpile weapons conducted in support of the annual certification process. Materials models and databases will be utilized to address weapons aging and reliability issues and to support the reliability and surety of remanufactured components. Verified and validated primary and secondary codes will be used to support the surveillance, assessment and refurbishment of the weapons systems in the nuclear weapons stockpile. Integration of achievements from ASCI with the ongoing Core Stewardship program is essential to provide high confidence in the safety, security, reliability and performance of the enduring U.S. nuclear stockpile, without underground nuclear testing.

Budget Contents

Core Stockpile Stewardship is broken into the following major categories: **Direct Stockpile Activities, Experimental Activities, Accelerated Strategic Computing Initiative, Special Projects, Performance Assessment Science & Technology, Systems Components Science & Technology,**

Chemistry & Materials Science & Technology, Stockpile Computing, Testing Capabilities and Readiness, Institutional and Infrastructure Requirements, and Construction.

Direct Stockpile Activities provide for initial design and development of all new weapon designs, if needed; preproduction design and engineering activities; design and development of weapon modifications; technical aspects of the laboratory surveillance and flight test program; and analysis behind safety studies and assessments. This program supports studies and research to apply basic science to weapon stockpile problems producing new technologies; products and processes in the vital surety areas (safety, security, and use control) technology development and implementation. The analysis needed to dismantle and safely store weapons being removed from the stockpile is provided. Verified and validated primary and secondary codes developed in the ASCI program will be integrated into the direct stockpile programs to support surveillance, assessment and refurbishment activities.

Experimental Activities support the ability to certify the enduring stockpile in the absence of underground nuclear testing, and improve our understanding of stockpile aging and the effects on reliability through experiments using high explosives and/or small quantities of special nuclear material. Experiments are conducted at the three nuclear weapons laboratories (Los Alamos, Lawrence Livermore, and Sandia National Laboratories) and at the Nevada Test Site (NTS). The experiments at the NTS also directly support Presidential direction to maintain the ability to safely conduct an underground nuclear test at the NTS within 2-3 years. Funding for the NTS contractors who support these experiments is included in the Testing Capabilities and Readiness budget category.

An important component of the experimental program is the subcritical experiments. Subcritical experiments are scientific experiments using chemical high explosives to generate high pressures which are applied to nuclear materials. High speed measurement instruments are used to obtain valuable scientific data about the behavior of those nuclear materials under conditions similar to those during the implosion phase of a nuclear weapon. The configuration and quantities of explosives and nuclear materials are designed so that no nuclear explosion will take place. The data obtained from subcritical experiments will help benchmark complex computer simulations of nuclear weapons performance and will be used to help certify the safety and reliability of the Nation's nuclear weapons stockpile. With the moratorium on underground nuclear testing, scientists and engineers compare experimental data with data from prior underground nuclear tests in order to validate or modify computational codes.

Accelerated Strategic Computing Initiative (ASCI) supports Defense Programs' response to the Presidential decision to pursue a zero-yield Comprehensive Test Ban Treaty. ASCI will build upon the successes achieved with the demonstrated 1 TeraOp performance on the Option Red and recent demonstrated performance of over 3 TeraOps on the Option Blue platforms ahead of schedule. ASCI continues its’ balanced approach to implementing the program through highly integrated strategies, such as, Advanced Applications; Platforms; Problem Solving Environments; Strategic Alliances; One Program\Three Labs; and Distributed Computing and Distance Computing, (DisCom^2). The ASCI program has developed high-end simulation capabilities (Advanced Applications and Platforms) needed to meet weapons assessment and certification (Problem Solving Environments and Advanced Applications) requirements without nuclear testing. The supercomputers developed under the ASCI program, along with associated diagnostic, modeling, and validation technologies, DisCom^2, and the Numeric Environment for Weapons Simulation, are key to supporting the execution of the Stockpile Stewardship Program. These strategies, taken collectively, are being pursued to accelerate the development of simulation codes, computer platforms and computing environments needed to address the challenges of credibly simulating the performance, safety, and reliability of the enduring nuclear stockpile with unprecedented levels of data fidelity.

Special Projects provide miscellaneous research, development and support activities necessary to carry out the Stockpile Stewardship Program, but which do not programmatically fit into any other category. Waste Management is included in this program.

Performance Assessment Science and Technology supports theoretical and experimental weapons physics research with an emphasis on anticipated future national security missions and requirements. This includes technical reviews of stockpile weapons conducted in support of the annual certification process, hydrotest and pulsed power experiments, in addition to advanced hydrotest and advanced pulsed power research. Advanced systems modeling developed under ASCI is utilized to address ongoing stockpile weapon system performance issues.

Systems Components Science and Technology includes research emphasizing the integration of warhead systems with delivery systems, and advancement of subsystem enabling technologies. This research includes component modularity, standardization, and reuse; utilization of microelectronic systems to improve safety, security and reliability; and development of the tools, methods, and processes needed to support future design and manufacturing requirements.

Chemistry and Materials Science and Technology provides research in materials science to address the unique set of issues relating to the specialized materials developed for, and used in, nuclear weapons. These activities are required to address the resolution of weapons aging and reliability issues; to support the remanufacture of stockpile components in a timely, cost effective, and environmentally benign way; and to enhance the reliability and surety of remanufactured components. Materials models and databases developed within ASCI are employed to address ongoing weapons issues in materials science.

Stockpile Computing conducts computing operations, develops models and provides code maintenance to support execution of Stockpile Stewardship. Stockpile Computing supports the development, enhancement, and maintenance of simulation codes and databases for the weapons program and research in theoretical physics, mathematical modeling, software and algorithms. These activities are essential in weapons safety and reliability assessments, stockpile life extension endeavors, design of physics experiments, developing appropriate diagnostics, and analyzing past nuclear experimental results. Areas of current and planned efforts include: assessments of complex/unique accident scenarios; improvements of predictive capability for weapon safety and performance analysis; improvement in weapon materials dynamic response models; multi-dimensional simulation of physics; visualization tools; and robotics algorithms.

The Stockpile Computing initiative entitled the Numeric Environment for Weapons Simulation (NEWS), begun in FY 1999, increases substantially in FY 2000 as planned, to keep pace with, and provide commensurate computational and computer infrastructure with planned program performance curves. The NEWS combines simulation codes and platforms with problem solving tools and visualization tools to allow large numbers of designers to use high-end simulation capabilities to address time-urgent stockpile issues such as surveillance, aging and re-manufacturing.

Testing Capabilities and Readiness provides a continental U.S. site for underground nuclear weapons testing at the Nevada Test Site (NTS). Consistent with Presidential direction, Defense Programs is required to maintain a readiness capability to safely conduct an underground nuclear test at the NTS within 2-3 years, if needed. In addition to maintaining the appropriate infrastructure, personnel, knowledge, and skills to meet this requirement, measures are to be taken to assure continued environmental, worker health, public safety, and physical protection. Presidential direction also requires that sufficient resources should be included to conduct experimental activities planned by the three nuclear weapons laboratories (Los Alamos, Lawrence Livermore, and Sandia National Laboratories).

In FY 1998, Defense Programs successfully conducted the third and fourth subcritical experiments, "Stagecoach" and “Bagpipe,” which provided data to improve the accuracy of computer simulations of nuclear weapons as part of the science-based Stockpile Stewardship Program, and were used to develop and refine diagnostics for the more complex subcritical experiments of the future. Extensive preparatory work was conducted on two experiments planned for FY 1999; it should be noted that most of the work and expenditures for an experiment occur prior to the actual date that the experiment occurs. In FY 1999 the first of those subcritical experiments, “Cimarron,” was conducted on December 11, 1998. The next planned experiment, “Clarinet,” is scheduled for the second quarter of FY 1999. Two subcritical experiments are planned for FY 2000. We expect that this effort will be maintained at 2 or 3 experiments annually throughout the planning period. Activities supporting the experimental program conducted at NTS by the laboratories also exercise skills needed to maintain test capabilities and readiness.

Institutional and Infrastructure Requirements evolved from a programmatic laboratory capital equipment and general plant project (GPP) budget category to institutional infrastructure support for Core Stockpile Stewardship sites. Funding in this category supports multiple laboratory programs or is of a basic infrastructure nature and therefore are not allocated to other Core Stockpile Stewardship Operations & Maintenance budget categories. Capital equipment or general plant project funding directly associated with a programmatic activity is budgeted accordingly.

Construction projects for Core Stockpile Stewardship, both programmatic and infrastructure in nature, support the DP mission at the three nuclear weapons laboratories and the Nevada Test Site. Details for all of the construction projects are included in the construction project data sheets.

Performance Measures (Presidential Measures are underlined)

- <u>Meet all annual weapons alteration and modification schedules developed jointly by DOE and DoD.</u>
- Conduct studies and development work required to support weapon systems and components for the future stockpile.
- <u>Annually report to the President on the need or lack of need to resume underground nuclear testing to certify the safety and reliability of the nuclear weapons stockpile.</u>
- Revalidate enduring stockpile systems to meet established military characteristics.
- Provide computer platforms sized to support the stewardship objective of full physics, high-fidelity simulations of nuclear weapons performance.
- Deliver three-dimensional, high-fidelity weapons performance codes by 2004.
- <u>Demonstrate a computer code capable of performing a three-dimensional analysis of the dynamic behavior of a nuclear weapon primary, including a prediction of the total explosive yield, on an ASCI computer system.</u>

- # Develop and implement visualization, networking and data management systems to efficiently support utilization of ASCI codes and computers across the weapons complex.

- # Meet all cost and schedule goals for construction of the Dual-Axis Radiographic Hydrodynamic Test Facility (DARHT) consistent with an FY 2002 completion.

- # Meet all cost and schedule goals for construction of the Contained Firing Facility at LLNL consistent with a 4th Quarter FY 2001 completion.

- # Meet all cost and schedule goals for construction of the Atlas Facility at LANL consistent with a 1st Quarter FY 2001 completion.

- # Obtain and assess information required to decide whether to construct 1) an advanced hydrotest facility and/or 2) an advanced pulsed power facility.

- # <u>Conduct two subcritical experiments at the Nevada Test Site to provide valuable scientific information about the behavior of nuclear materials during the implosion phase of a nuclear weapon.</u>

- # Conduct experimental and theoretical research necessary to maintain or advance research, development and engineering capabilities in nuclear materials science and weapons design.

- # Conduct high energy density research on inertial confinement fusion facilities necessary to enhance understanding of areas of physics relevant to a better predictive assessment of nuclear weapons performance.

- # <u>Ensure that all facilities required for successful achievement of the Stockpile Stewardship Plan are operational.</u>

- # Adhere to schedules set forth in the Advanced Manufacturing, Design and Production Technology Multi-Year Program Plan.

- # Implement the Strategic Alignment Initiative and recommendations of the 120-Day Study.

- # Continue material protection, control, and accountability upgrades at three DOE facilities with weapons-usable material.

- # <u>Ensure that the capability to resume underground nuclear testing is maintained, in accordance with the Presidential Decision Directive and Safeguard C of the CTBT.</u>

- # <u>Adhere to schedules for the safe and secure dismantlement of approximately ***375*** nuclear warheads that have been removed from the U.S. nuclear weapons stockpile.</u>

Funding Schedule

	(dollars in thousands)				
	FY 1998	FY 1999	FY 2000	$ Change	% Change
Operations and Maintenance					
Direct Stockpile Activities	179,103	177,848	215,452	+37,604	+21.1%
Experimental Activities	57,120	54,526	59,011	+4,485	+8.2%
Accelerated Strategic Computing Initiative	223,529	300,926	341,000	+40,074	+13.3%
Special Projects	15,485	92,012	83,278	-8,734	-9.5%
Performance Assessment Science & Technology	248,593	237,559	297,100	+59,541	+25.1%
Systems Components Science & Technology	114,253	101,680	102,830	+1,150	+1.1%
Chemistry & Materials Science & Technology	57,258	59,250	103,084	+43,834	+74.0%
Stockpile Computing	150,560	182,800	201,500	+18,700	+10.2%
Testing Capabilities & Readiness	180,977	190,500	177,126	-13,374	-7.0%
Institutional & Infrastructure Requirements	54,226	56,201	54,974	-1,227	-2.2%
Total, Operations and Maintenance	1,281,104	1,453,302	1,635,355	+182,053	+12.5%
Construction	98,810	107,126 [a]	133,145	+26,019	+24.3%
Total, Core Stockpile Stewardship	1,379,914	1,560,428	1,768,500	+208,072	+13.3%

[a] Reflects reprogramming of $3,683,000 (98-R-4), approved November 1998.

Detailed Program Justification

	(dollars in thousands)		
	FY 1998	FY 1999	FY 2000
Direct Stockpile Activities			
# The Stockpile Readiness Program supports activities on stockpile weapons to maintain or expand the understanding on the original development work, assess current reliability and safety status, respond to design issues and questions, and support the multi-agency Project Officers Group for each weapon system	53,344	55,593	61,295
# The Stockpile Reduction Program develops dismantlement procedures, provides liaison and technical support, and assists in the dismantlement of weapons and components designed by each weapons design laboratory	9,680	9,122	8,444
# The Enduring Stockpile Program includes revalidation of enduring stockpile weapon systems to meet military characteristics and development work necessary for refurbishment efforts like the W87 Peacekeeper Stockpile Life Extension Program (SLEP)	75,963	76,318	62,297
# The Future Stockpile Program includes activities directed toward possible future stockpile modifications such as the Submarine Launched Ballistic Missile (SLBM) Warhead Protection Program (WPP), a cooperative program between the Navy and DOE to exercise and maintain expertise for SLBM systems and to demonstrate replacement warhead options for possible future deployment, if needed. The Stockpile Life Extension Programs (SLEP) will provide Full Scale Engineering Development (FSED) and other required phase 6.2A and 6.3 activities for the W76 and W80, including support for the refurbishment First Production Unit (FPU) date of FY 2005 for the W76 and FY 2006 for the W80	40,116	36,815	60,016
# Systems verification and validation simulation efforts, incorporating the advanced computation and simulation of primary and secondary codes, to support stockpile weapon systems	0	0	23,400
Total, Direct Stockpile Activities	179,103	177,848	215,452

	(dollars in thousands)		
	FY 1998	FY 1999	FY 2000
Experimental Activities			
# Archiving activities to identify and preserve information on stockpile weapon design parameters, production and engineering data, and data from nuclear and nonnuclear tests that support the certification of current stockpile weapons . . .	13,482	12,595	13,796
# Hydrodynamic experiments to assess nuclear components including subcritical experiments. Two subcritical experiments will be conducted in FY 2000	36,638	33,521	37,246
# Aboveground experiments to assess and certify nonnuclear stockpile weapons subsystems and component hardware to neutron, x-ray, and gamma-radiation	7,000	8,410	7,969
Total, Experimental Activities	57,120	54,526	59,011
Accelerated Strategic Computing Initiative (ASCI)			
# Advanced Applications / Problem Solving Environments efforts greatly enhance physics in 3-D computer codes that provide unprecedented levels of fidelity in weapons simulations to maintain the path forward to the goal of 100 TeraOps performance through intermediate milestones of 10 and 30 TeraOps planned for 2000 and 2002, respectively. FY 2000 efforts in Advanced Applications will focus on 3-D codes capable of demonstrating the dynamic behavior of a nuclear weapons primary and demonstration of the dynamic response of a weapon system in the hostile radiation and blast of reentry	132,801	144,750	115,912
# Problem Solving Environments involves crosscutting support to the other strategies in ASCI and involves working closely with U.S. industry to accelerate development and mitigate impediments to provide computer systems far exceeding current industry projections, but essential to Stockpile Stewardship	23,683	44,300	58,286

	(dollars in thousands)		
	FY 1998	FY 1999	FY 2000
# Platforms activities provide the supercomputer systems needed to attain the planned path forward to the goal of 100 TeraOps performance level by 2004. Intermediate milestones of 10 and 30 TeraOps will be met in FY 2000 by completing and installing a basic development environment for the 10 TeraOps Option White system and completing acceptance of this system. Selection of a 30 TeraOps computer supplier is also planned for FY 2000	37,955	55,400	78,300
# Strategic Alliances will allow the ASCI program to engage U.S. universities on critical simulation capability problems addressing physics, materials modeling, fire and explosives safety and computer science issues in Level I Alliance. In FY 2000 each Alliance Level I center is expected to complete an integrated application code and demonstrate it on an ASCI computer system	24,938	12,490	32,400
# Distributed Computing and Distance Computing ($DisCom^2$) efforts will continue with this strategy which was begun in FY 1999, that will enable the ASCI and Stockpile Computing program to deliver key remote computing, visualization and communications technologies that complement the ASCI vision	0	25,950	47,192
# Verification and validation efforts begun in FY 1999 have been integrated in the core program to utilize direct stockpile data	0	10,150	0
# One Program / Three Labs continues with its integration strategy and provides the means to leverage other ASCI strategies and provides an appropriate level of coordination among the labs	4,152	7,886	8,910
Total, Accelerated Strategic Computing Initiative (ASCI)	223,529	300,926	341,000

	FY 1998	FY 1999	FY 2000
	(dollars in thousands)		
Special Projects			
# Waste Management and other activities which do not fit into other budget categories, or for which special visibility is necessary. This category includes funding for Waste Management at Los Alamos and Sandia National Laboratories in FY 1999 and FY 2000; a portion of the funding in FY 2000 at Sandia for Waste Management is funded by Stockpile Management	599	77,540	70,363
# Extraordinary ES&H Site Remediation activities address one-time corrective actions such as decontamination, decommission and demolition of surplus facilities at Sandia National Laboratories, and the "re-canning" of stored plutonium at Lawrence Livermore National Laboratory under the Defense Nuclear Facilities Safety Board Recommendation 94-1	2,523	2,419	1,394
# The Joint DoD/DOE Munitions Technology Development Program leverages the resources of the Department of Defense and the DOE to improve the capabilities of nonnuclear munitions technology and advance the science base for nuclear stockpile stewardship in areas of mutual interest between the two agencies. Activities are coordinated through a 5-year plan that is updated and approved annually by both agencies	11,463	11,035	10,501
# Nuclear Criticality activities at Los Alamos National Laboratory in response to the Department's Implementation Plan for the Defense Nuclear Facilities Safety Board Recommendation 97-2	900	1,018	1,020
Total, Special Projects	15,485	92,012	83,278
Performance Assessment Science & Technology			
# Performance assessment activities to explore concepts and technologies that offer potential options for meeting future national security requirements. These activities do not involve formal hardware development; however, they may include a limited amount of prototyping or experimentation to assess or demonstrate conceptual feasibility and they often require intensive computational analysis	65,891	52,224	47,407

	FY 1998	FY 1999	FY 2000
# Basic weapons physics research for both nuclear and nonnuclear components, radiation source development, and development of improved diagnostics for use in aboveground experimental facilities. Issues involving hydrodynamics, radiation, plasma, nuclear, solid state, optical, and chemical physics are being addressed to improve understanding of physics and code validation, and to sustain the skills of theoretical and experimental scientists. Weapons-related physics experiments on inertial fusion facilities are also supported. Pulsed power experiments are conducted on Pegasus, Z, Atlas, and Saturn; and hydrotest experiments are conducted at PXR and Phermex	136,819	134,871	143,757
# The Los Alamos Neutron Scattering Center (LANSCE) is the primary facility for Stockpile Stewardship Program researchers to conduct research addressing issues in neutron science. Defense Programs maintenance of this facility allows it to support other users within DOE	33,721	34,893	38,423
# Advanced Hydrodynamic Radiography conducts research in and develops linear induction accelerator technology, inductive voltage adder technology, and proton radiography as technology options for a future Advanced Hydrotest Facility	12,162	15,571	19,671
# Advanced systems modeling developed in ASCI to address ongoing stockpile weapon system performance issues	0	0	47,842
Total, Performance Assessment Science and Technology	248,593	237,559	297,100
Systems Components Science and Technology			
# Systems Engineering activities which facilitate the incorporation of new technologies into weapon systems and stockpile stewardship operations	64,165	56,482	56,268
# Electronics, Photonics, Sensors and Mechanical Components support research in enabling technologies which control and operate nuclear weapons including intelligent systems which monitor and diagnose the condition of weapons with regard to aging, functional status, intrusion/tamper detection, and anticipated performance	33,188	34,470	36,361

(dollars in thousands)

	(dollars in thousands)		
	FY 1998	FY 1999	FY 2000
# Advanced Manufacturing efforts develop the cost-effective, environmentally acceptable product realization tools, methods, and processes in direct support of the nuclear weapons stockpile	16,900	10,728	10,201
Total, Systems Components Science and Technology	114,253	101,680	102,830
Chemistry and Materials Science and Technology			
# Chemistry and Materials supports research on materials synthesis and processing, determination of materials structure and composition, and development of functional properties in polymers, metals, ceramics, inorganic and organic materials, composites, and salts	13,098	12,935	11,949
# High Explosives involves fundamental physics and chemistry of explosive materials, characterization and modeling of explosive properties, improvement of firing technology, investigation of demilitarization technologies, and engineering of explosive component prototypes and their evaluation for weapons use	14,768	17,283	17,830
# Special Nuclear Materials activities support the development of advanced and automated processing, casting, dynamic testing and machining technologies for beryllium, plutonium, and uranium	24,114	22,931	24,644
# Tritium activities support research on the production, disassembly, handling, and use of tritium and its compatibility with other materials and components and focuses on four main areas: gas transfer, solid storage systems, neutron generator tubes, and inertial fusion targets	5,278	6,101	6,161
# Materials models and databases developed within ASCI are combined with ongoing materials modeling efforts to address ongoing weapons issues in materials science	0	0	42,500
Total, Chemistry and Materials Science and Technology	57,258	59,250	103,084

	FY 1998	FY 1999	FY 2000
	(dollars in thousands)		
Stockpile Computing			
# Stockpile Computing base program activities will continue along with code development and maintenance efforts to improve 3-D "more complete physics" modeling codes in support of the enduring stockpile	150,560	155,200	134,230
# Numeric Environment for Weapons Simulation will provide implementation of a local computational environment for a large number of weapons designers to use high end simulation capabilities, such as rapid visualization of stockpile surveillance activities in order to "see and understand" the effects of aging on the stockpile and its associated phenomena	0	27,600	67,270
Total, Stockpile Computing	150,560	182,800	201,500
Testing Capabilities and Readiness			
# Supports Defense Programs' plans to conduct two subcritical experiments in the U1a complex at the NTS in FY 2000. Also includes funding for upgrades and expenses of the U1a complex in accordance with the upgrade plan	60,090	63,341	48,930
# Support to the weapons laboratories for nonnuclear experiments conducted at the NTS, primarily at the Big Explosive Experimental Facility (BEEF)	4,733	3,255	4,700
# Support to the weapons laboratories for experimental activities at locations other the NTS (mainly the weapons laboratories)	18,343	19,106	18,857
# Experimental diagnostics activities which support experiments conducted both on and off the NTS, including some potentially used for the NIF, and in support of the nuclear test readiness mission	10,948	14,767	20,266
# Support for activities vital to maintaining a capability to resume underground nuclear testing within 2-3 years that are not exercised as a byproduct of the experimental program	34,888	30,410	29,023

	(dollars in thousands)		
	FY 1998	FY 1999	FY 2000
# Technical Facility Operations and Management supports experimental and nuclear test readiness functions, including operations of the Device Assembly Facility (DAF), and the two-stage gas gun (R&D, general plant project, operational testing, and startup)	19,704	24,446	24,902
# Other activities supporting the direct program, including the Cooperative Agreement with the University of Nevada, and the radio upgrade project at the NTS	32,271	35,175	30,448
Total, Testing Capabilities and Readiness	180,977	190,500	177,126
Institutional & Infrastructure Requirements			
# Institutional Capital Equipment that supports multiple laboratory programs or is of a basic infrastructure nature and therefore is not allocated to other Core Stockpile Stewardship Operations & Maintenance budget categories	39,122	37,001	36,774
# Institutional General Plant Projects that supports multiple laboratory programs or is of a basic infrastructure nature and therefore is not allocated to other Core Stockpile Stewardship Operations & Maintenance budget categories. Examples include: decontamination & decommissioning refueling and service facility, removal of adjacent transportables, inadequate parking at technical area 3, etc.	15,104	19,200	18,200
Total, Institutional & Infrastructure Requirements	54,226	56,201	54,974
Construction			
# See “Capital Operating Expenses and Construction Summary” for details	98,810	107,126	133,145
Total, Core Stockpile Stewardship	1,379,914	1,560,428	1,768,500

Explanation of Funding Changes from FY 1999 to FY 2000

	FY 2000 vs. FY 1999 ($000)
Direct Stockpile Activities	
# Decreased laboratory support for the dismantlement program and other minor program reallocations consistent with Nuclear Weapons Stockpile Memorandum (NWSM) defined workload	-4,314
# Decreased development work to support for the W87 Peacekeeper Stockpile Life Extension Program (SLEP) to reflect first production and certification in FY 1999 . .	-7,230
# Conduct Full Scale Engineering Development activities and other required activities to support refurbishment First Production Unit date of 2005 for the W76 Trident SLEP	+21,000
# Develop and validate potential refurbishment options within the Submarine Launched Ballistic Missile (SLBM) Warhead Protection Program (WPP)	+4,748
# Systems verification and validation efforts have been integrated into this budget category to utilize direct stockpile data	+23,400
Total, Direct Stockpile Activities	+37,604
Experimental Activities	
# FY 1999 activities in this area were reduced as a result of the unavailability of prior year balances to offset the final FY 1999 appropriation (impacts and allocations of these program reductions have not been finalized at the subprogram activity level); FY 2000 activities approximate the FY 1998 program level and support two subcritical experiments. Archiving and experimental activities by the weapons laboratories support both test readiness and certification of the nuclear stockpile . . .	+4,485
Accelerated Strategic Computing Initiative	
# ASCI increases in the 5th year of the program are planned to accomplish the program goal of attaining 100 TeraOps of computational performance by 2004 as well as intermediate milestones of 10 and 30 TeraOps planned for 2000 and 2002, respectively. In FY 2000, ASCI activities grow by 13 percent, attributable to the following planned growth in the program elements	
# Advanced Applications \ Problem Solving Environments decreases 8 percent to reflect integration of models and systems developed in ASCI into ongoing core stewardship activities, and reflects efficiencies in code compilation efforts	-14,852

	FY 2000 vs. FY 1999 ($000)
# Platforms increases $22.9 million, or 41 percent, to support the completion efforts of the 3 TeraOps Option “Blue” system and the planned technology refreshes associated with this system as well as costs associated with the 10 TeraOps Option White system.	+22,900
# Strategic Alliances increases to continue funding of the existing Level I Alliance Agreements with academia as well as initiate some Level II and III Alliance proposals. Recipients of Alliance work to date include the California Institute of Technology, Stanford University, the University of Chicago, the University of Utah and the University of Illinois at Urbana/Champaign. Types of approved Alliance work include: simulation of dynamic responses of metals; turbulence simulations; astrophysics; and fire and explosives safety.	+19,910
# One Program\Three Labs increases 13 percent and represents the continuation of the strategy to integrate and align the weapons laboratories with each other and the complex to fulfill ASCI mission goals. This strategy encompasses the planned program collaboration meetings, topical and Principal investigators meetings, program planning, outreach and crosscuts.	+1,024
# Verification and Validation decreases as matured codes are integrated in the core program to utilize direct stockpile data.	-10,150
# Distributed Computing and Distance Computing (DisCom^2) increases 82 percent to accelerate the development and deployment of a pre-eminent design, analysis, and (re)manufacturing capabilities that will serve as an enterprise-wide computational fabric which extends the required simulation environments to support high-end computing at remote sites	+21,242
Total, Accelerated Strategic Computing Initiative	+40,074
Special Projects	
# Funding decrease reflects the allocation of the cost of waste management activities at SNL to waste generators	-6,107
# Funding decrease for Extraordinary ES&H Site Remediation, DoD Munitions MOU, and other miscellaneous activities	-2,627
Total, Special Projects	-8,734

	FY 2000 vs. FY 1999 ($000)
Performance Assessment Science and Technology	
# Minor program reallocations to support the certification of the stockpile and advanced experimental capabilities	-712
# Increased support to conduct hydrotest experiments in support of certification and to establish a baseline from which future changes to stockpile weapons can be detected and measured	+4,781
# Conduct neutron science research at the LANSCE facility, increase operating beam time by two months, and utilize two new "fast track" spectrometers	+3,530
# Increase support to conduct research in and develop linear induction accelerator technology, inductive voltage adder technology, and proton radiography as technology options for a future Advanced Hydrotest Facility	+4,100
# Advanced systems modeling being verified and validated and integrated into ongoing technical reviews	+47,842
Total, Performance Assessment Science and Technology	+59,541
Systems Components Science and Technology	
# FY 1999 activities in this area were reduced as a result of the unavailability of prior year balances to offset the final FY 1999 appropriation (impacts and allocations of these program reductions have not been finalized at the subprogram activity level); FY 2000 activities approximate the revised FY 1999 program level	+1,150
Chemistry and Materials Science and Technology	
# Materials models and databases developed in ASCI will be verified and validated and integrated into ongoing materials research to address weapon aging and remanufactured component reliability and surety issues	+42,500
# FY 1999 activities in the balance of this area were reduced as a result of the unavailability of prior year balances to offset the final FY 1999 appropriation (impacts and spreads of these program reductions have not been finalized at the subprogram activity level); FY 2000 activities approximate the revised FY 1999 program level	+1,334
Total, Chemistry and Materials Science & Technology	+43,834

	FY 2000 vs. FY 1999 ($000)
Stockpile Computing	
# The Stockpile Computing base program decreases 14 percent, based on planned workload requirements relating to hardware and software maintenance; computer operations; system administration, support and integration; configuration and resource management; computer security; and integration of systems. System networks upgrades to enhance data transfer speeds and data storage continue to expand as technology for high density storage advances	-20,970
# Numeric Environment for Weapons Simulation (NEWS), begun in FY 1999, increases to provide data exploration corridors commensurate with ASCI program advances in the advanced applications; platforms; and problem solving environments strategies	+39,670
Total, Stockpile Computing	+18,700
Testing Capabilities and Readiness	
# Defense Programs plans to conduct two subcritical experiments in the U1a complex at the Nevada Test Site (NTS) in FY 2000. The FY 1999 funding level supported 3 to 4 subcritical experiments	-10,711
# Funding for upgrades and expenses of the U1a complex decrease in accordance with the upgrade plan	-3,700
# Minor program reallocations to support the experimentation and nuclear test readiness objectives at the NTS	+1,037
Total, Testing Capabilities and Readiness	-13,374
Institutional & Infrastructure Requirements	
# Funding for institutional capital equipment and general plant projects is decreased due to the need to maintain scientific and technical staff and experimental facilities.	-1,227

	FY 2000 vs. FY 1999 ($000)

Construction

- # Core Stockpile Stewardship Construction continues funding of all ongoing construction projects and initiates three new infrastructure projects in FY 2000. The three new projects will provide the unique floor space and scalable architecture for power and cooling capabilities needed at the laboratories to house state-of-the-art computers as well as provide visualization and other capabilities to maximize the utility of the significant advances in computing capabilities by the weapon designers. Construction of these facilities is supported through the 5-year period . . . . +26,019

Total Funding Change, Core Stockpile Stewardship . . . . +208,072

Capital Operating Expenses & Construction Summary

Capital Operating Expenses

(dollars in thousands)

	FY 1998	FY 1999	FY 2000	$ Change	% Change
General Plant Projects . . . . [a]	22,948	23,000	23,000	0	0.0%
Capital Equipment . . . . [b]	58,259	59,000	59,000	0	0.0%
Total, Capital Operating Expenses	81,207	82,000	82,000	0	0.0%

Construction Projects

(dollars in thousands)

	Total Estimated Cost (TEC)	Prior Year Approp-riations	FY 1998	FY 1999	FY 2000	Unappro-priated Balance
00-D-107, Joint Computational Engineering Laboratory (JCEL), SNL	28,870	0	0	0	1,800	27,070
00-D-105, Strategic Computing Complex, LANL	100,000	0	0	0	26,000	74,000
00-D-103, TeraScale Simulation Facility, LLNL	83,500	0	0	0	8,000	75,500
99-D-108, Renovate Existing Roadways, NV	11,005	0	0	2,000	7,005	2,000
99-D-106, Model Validation & System Certification Test Center, SNL	18,230	0	0	1,600	6,500	10,130
99-D-105, Central Health Physics Calibration Facility, LANL	3,900	0	0	2,900	1,000	0
99-D-104, Protection of Real Property-Roof Reconstruction-Ph. II, LLNL	19,900	0	0	2,500	2,400	15,000
99-D-103, Isotope Sciences Facility, LLNL	17,400	0	0	2,000	2,000	13,400
99-D-102, Rehabilitation of Maintenance Facility, LLNL	7,900	0	0	4,000	3,900	0
97-D-102, Dual-Axis Radiographic Hydrotest Facility, LANL	259,700	81,400	46,300	36,000	61,000	35,000

[a] Since funds are appropriated for Operations and Maintenance, which includes operating expenses, capital equipment and general plant projects, we no longer budget separately for capital equipment. Funding shown reflects estimates based on FY 1998 obligations.

[b] Since funds are appropriated for Operations and Maintenance, which includes operating expenses, capital equipment and general plant projects, we no longer budget separately for general plant projects. Funding shown reflects estimates based on FY 1998 obligations.

	Total Estimated Cost (TEC)	Prior Year Approp-riations	FY 1998	FY 1999	FY 2000	Unappro-priated Balance
96-D-105, Contained Firing Facility Addition, LLNL	49,700	23,700	19,300	6,700	0	0
96-D-104, Processing & Environmental Technology Laboratory, SNL	45,900	16,080	0	18,920	10,900	0
96-D-103, Atlas, LANL	43,300	23,500	13,400	6,400	0	0
96-D-102, Stockpile Stewardship Fac. Revit. Ph. VI, VL:						
- Water Well Replacements, LANL	16,800	11,200	4,500	1,100	0	0
- Fire Protection Improvements, LANL	16,900	6,570	5,450	4,880	0	0
- 138kV Substation Modernization, NTS . . .	11,992	1,000	2,667	6,350 [a]	1,975	
- Real Property Protection (Roofs), LLNL . .	7,810	3,000	4,810	0	0	0
- Storm Drain, Sanitary Sewer & Domestic Water, SNL	15,374	0	1,483	7,326	665	5,900
- Site 300 Fire Station/Medical Facility, LLNL	5,350	0	900	4,450	0	0
Total, Core Stewardship Construction		166,450	98,810	107,126	133,145	258,000

Major Items of Equipment *(TEC $2 Million or Greater)*

(dollars in thousands)

	Total Estimated Cost (TEC)	Prior Year Approp-riations	FY 1998	FY 1999	FY 2000	Acceptance Date
Short Pulse Spallation Source	16,400	3,000	6,000	7,700	0	FY 2000
Radio Conversion	18,000	0	0	3,000 [b]	6,000	FY 2002
Plasma Deposition Tool	2,200	0	0	2,200	0	FY 1999
Deep Ultraviolet Stepper	4,000	0	0	0	4,000	FY 2000
Total, Major Items of Equipment		3,000	6,000	12,900	10,000	

[a] Reflects reprogramming of $3,683,000 (98-R-4), approved November 1998.

[b] Reflects reallocation of operations and maintenance funding within Testing Capabilities and Readiness.

Inertial Confinement Fusion

Mission Supporting Goals and Objectives

The mission of the Inertial Confinement Fusion (ICF) program is twofold: (1) to address high energy density physics issues as a key component of the science-based Stockpile Stewardship program, and (2) to develop a laboratory microfusion capability for defense and energy applications. The near-term goals pursued by the ICF program in support of this mission are demonstrating ignition in the laboratory and expanding the program's capabilities in high energy density science. The National Ignition Facility (NIF) is the cornerstone of this effort.

The program contributes to the goals of the Weapons Stockpile Stewardship program by:

- providing facilities and capabilities needed to study many of the basic and applied science issues underlying stockpile stewardship;
- conducting experiments to validate and verify the advanced weapons simulation codes being developed by the core nuclear weapons program and the Accelerated Strategic Computing Initiative (ASCI) to assess the reliability and effects of aging on weapons in the stockpile;
- providing calculational techniques to model high energy density phenomena in new simulation codes; and
- helping to retain the high quality of scientific and technical expertise necessary for national security.

Technical Background

ICF focuses energy from a "driver," typically a laser or ion beam accelerator, to implode and compress a small, spherical capsule shell containing deuterium and tritium (DT) fuel. The "inertia" of the compressed fuel keeps the reactants together long enough, under the proper conditions, for the fusion ignition and burn to occur. The goal is to achieve "gain," that is, to get more energy out of the system than was put into the system. The ICF capsule can be imploded in one of two ways: direct or indirect drive. In the direct drive approach, the driver energy is focused directly onto the capsule to drive the implosion. In the indirect drive approach, the driver energy is directed into a radiation enclosure, or hohlraum, generating a uniform soft x-ray environment which then drives the capsule. In either case, the irradiation energy must be uniformly absorbed in the capsule's outer ablator layer. The heated ablator material rapidly blows off symmetrically. The rocket-like reaction force causes the "pusher" and the remaining portion of the fuel capsule to spherically implode, compressing and heating the DT fuel to ignition. The same technique that provides capsule implosion provides radiation environments for the study of high energy density physics that occur in weapons. Experiments on ICF facilities can also address radiation flow, hydrodynamics, equation of state and opacity issues specifically for weapon analyses.

The ICF program has developed unique capabilities in pursuit of its national mission. The laser and pulsed power facilities developed under the ICF program, along with associated diagnostic, modeling, and target fabrication components, are the most advanced array of high energy density physics research capabilities in the world. These facilities support science based stockpile stewardship while advancing inertial fusion technology toward a laboratory ignition demonstration with multi-megajoule fusion yields. Over the next five years, most of the ICF resources are allocated to an integrated theoretical and experimental program (high energy density physics studies, target fabrication, laser science, computation) to advance the technology in support of achieving ignition and other weapon physics experiments. Demonstration of ignition and burn in the laboratory is the most challenging goal of the National Ignition Facility (NIF), which is using glass laser technology and is on schedule to be completed at the end of FY 2003.

Program Goals

- Demonstrate fusion ignition in the laboratory.
- Provide access to physics regimes of interest in nuclear weapon science and investigate physics issues.
- Expand the aboveground simulation capability for nuclear weapons effects.
- Develop diagnostic instruments applicable to weapons stockpile stewardship research.
- Develop and experimentally benchmark computational models, including testing of three-dimensional simulation capabilities.
- Attract and retain highly competent scientists and engineers within the nuclear weapons program.

Program Facilities

- Beamlet: a scientific prototype of one beam of the NIF located at LLNL . It began operating experiments in 1994. It was shut down during FY 1998 and was shipped to SNL for use as a "backlighter" diagnostic on the Z facility.
- National Ignition Facility (NIF): a 192-beam neodymium (Nd) glass laser being built at Lawrence Livermore National Laboratory (LLNL). It is scheduled to be completed at the end of FY 2003.
- Nike: a Krypton-fluoride (KrF) laser located at the Naval Research Laboratory (NRL). It was completed in FY 1995 and is being used primarily to define beam smoothness requirements for direct drive laser fusion.
- Nova: a ten-beam glass laser located at LLNL. It has been the program's major facility for research on indirect drive laser fusion, and has made important contributions to stockpile stewardship and basic experiments on high energy density physics since it began operating in 1985. Nova will be shut down in FY 1999.
- Omega: a 60-beam glass laser used primarily for research on direct drive laser fusion located at the University of Rochester's Laboratory for Laser Energetics (UR/LLE). This facility was upgraded beginning in FY 1991 and began operating in the upgraded configuration in May 1995. During FY 1998, the facility began fielding weapons physics experiments (including classified). Omega will serve as the "bridge" facility between the shutdown of Nova and the startup of NIF.
- Z: a pulsed power machine used for inertial fusion research, located at Sandia National Laboratories (SNL). It has made many significant technological breakthroughs since it began operating as a z-pinch device in October 1996 and now conducts weapons physics and ignition related experiments.
- Trident: a smaller glass laser facility at Los Alamos National Laboratory (LANL) used for diagnostic testing and development, as well as weapons and basic physics experiments.

Performance Measures

Continue construction of the National Ignition Facility according to its Project Execution Plan schedules.

Conduct high energy density research on inertial confinement fusion facilities necessary to enhance understanding of areas of physics relevant to a better predictive assessment of nuclear weapons performance.

Significant Accomplishments

Awarded all of the major physical construction contracts on the NIF. Construction well underway on the Optics Assembly Building, Target Area Building and Laser Building.

By the end of FY 1998, completed nearly all of the Title II designs on special equipment items, and awarded contracts for support structures, laser auxiliary systems and target auxiliary systems.

Zygo in Connecticut completed construction of their 25,000 square foot NIF optics manufacturing facility in February 1998 to be used for finishing NIF amplifier slabs and mirrors.

Schott Glass Technologies in Pennsylvania completed construction of its NIF laser glass building, and Hoya in California completed a subscale melter demonstration for NIF laser glass in March 1998.

Tinsley completed its 30,000 square foot facility for polishing NIF lenses and windows in Richmond, California in November 1998.

On January 29, 1998, LLNL unveiled the world's largest KDP crystal. Grown in a record 6 weeks, it was 20 inches across, slightly less than 3 feet tall, and weighed 500 pounds. These fast growth crystals will be sliced into 1-cm thick plates to be used to change the color and switch the direction of the laser beams on NIF. 100 to 150 of these crystals are needed over the next five years for the NIF.

Improved z-pinch dynamics on Saturn and Z have significantly enhanced total x-ray powers for stewardship missions -- achieved 2 MJ of x-ray energy and 290 TW of x-ray power on Z.

Awarded 14 grants under the Inertial Fusion Science in Support of Stockpile Stewardship Program for unclassified innovative research in high-energy-density science.

Initiated classified weapons physics experiments on the Omega facility at the University of Rochester to compensate for the shutdown of Nova in FY 1999.

ICF Funding by Laboratory

	(dollars in thousands)		
	FY 1998	FY 1999	FY 2000
Base ICF Program (excludes NIF)			
Lawrence Livermore National Laboratory	89,846	102,242	107,500
Los Alamos National Laboratory	21,896	21,940	23,000
Sandia National Laboratories	24,500	31,000	30,000
University of Rochester/Laboratory for Laser Energetics	26,299	28,800	30,450
Naval Research Laboratory	9,000	16,758	9,500
General Atomics	10,937	8,870	7,000
Headquarters	27	102	1,550
Oakland Operations Office	1,849	2,670	2,700
Total, Base ICF Program	184,354	212,382	211,700
National Ignition Facility			
National Ignition Facility - Other Project Costs	31,300	6,800	5,900
Construction (96-D-111)	197,800	284,200	248,100
Total, National Ignition Facility	229,100	291,000	254,000
Total, Inertial Confinement Fusion	413,454	503,382	465,700

Funding Schedule

	(dollars in thousands)				
	FY 1998	FY 1999	FY 2000	$ Change	% Change
Operations & Maintenance					
Base ICF Program	184,354	212,382	211,700	-682	-0.3%
National Ignition Facility - Other Project Costs	31,300	6,800	5,900	-900	-13.2%
Total, Operations & Maintenance	215,654	219,182	217,600	-1,582	-0.7%
Construction - National Ignition Facility (96-D-111)	197,800	284,200	248,100	-36,100	-12.7%
Total, Inertial Confinement Fusion	413,454	503,382	465,700	-37,682	-7.5%

Detailed Program Justification

	(dollars in thousands)		
	FY 1998	FY 1999	FY 2000
Base ICF Program			
Target Physics, Theory and Modeling			
Target physics experimental activities are supported to resolve target physics issues on both indirect and direct drive, including laser imprinting and hydrodynamic instability growth. Included are activities related to ignition, as well as weapons physics experiments on radiation flow, opacity, hydrodynamics, and material equation of state. In FY 2000, a major emphasis in this area will be the recruitment and training of operators for NIF. Approximately 60 operators will be trained at LLNL during FY 2000 for first bundle and laser bay 2 operations. This activity will also support the operations of the Optics Assembly Building where all of the NIF modules will be prepared for facility installation. Development of prototype ignition targets and minimal fabrication of initial NIF diagnostics will begin in FY 2000. The backlighter diagnostic for the Z facility at Sandia will be completed during FY 2000 which will enhance the experimental value of this facility for weapons physics science. NRL will continue experiments in FY 2000 to evaluate the potential for direct drive ignition on NIF. UR/LLE will address critical issues of direct-drive ICF physics in FY 2000, including work on "warm" physics and improvements in laser imprinting and Raleigh-Taylor growth-rate mitigation. A small amount of funding is included at HQ to support critical National Ignition Plan activities at currently undetermined sites. Allocation of funding among sites for this effort will be determined during execution of the FY 2000 budget	101,463	133,618	160,733
Target Development, Fabrication and Handling			
Research, development, fabrication and delivery of non-cryogenic and cryogenic targets are supported at all of the sites; however, cryogenic research and development at General Atomics is not directly supported in FY 2000	26,245	24,157	20,322
Laser and Optics Technology Development			
Glass laser and optics component validation for NIF and Omega are supported. NIF optics pilot production, the culmination of the NIF laser and optics technology development effort, will be completed early in FY 2000	48,561	41,037	26,742

	FY 1998	FY 1999	FY 2000
Advanced Driver Development			
Experimental activities on advanced pulsed-power accelerators, advanced glass laser concepts such as diode pumped solid state lasers, and advanced KrF driver concepts needed for the future (beyond NIF) have been supported in the past; however, given resource constraints, funding is not requested for this activity in FY 2000	5,398	9,750	0
Other ICF Activities			
Independent technical review of the ICF program (e.g. National Academy of Sciences), the National Laser Users Facility, and other user activities, including an individual investigator grant program in high energy density science relevant to ICF are supported	2,687	3,820	3,903
Total, Base ICF	184,354	212,382	211,700
National Ignition Facility			
National Ignition Facility - Other Project Costs			
The operations and maintenance funded activities that are directly related to the NIF, including research and development necessary to complete construction, conceptual design, NEPA documentation, and other project related costs are supported. Optics vendor facilitization will be completed during FY 2000	31,300	6,800	5,900
Construction (96-D-111)			
Provides the line item funding for the Total Estimated Cost (TEC) of the National Ignition Facility. FY 2000 funding represents the funding required to meet the approved schedule for NIF. During FY 2000, Switchyard 2, Laser Bay 2, and the Target Bay will be commissioned for installation of special equipment and the Target Chamber will be installed	197,800	284,200	248,100
Total, National Ignition Facility	229,100	291,000	254,000
Total, Inertial Confinement Fusion	413,454	503,382	465,700

(dollars in thousands)

Explanation of Funding Changes from FY 1999 to FY 2000

	FY 2000 vs. FY 1999 ($000)

Base ICF Program

Target Physics, Theory and Modeling

# Increase primarily due to the start of the transition from Nova operations to the ramp-up to NIF operations. Increase includes operations procedures preparation, operator training, operations support equipment, optics processing, and operations of the Optics Assembly Building. Funding will partially support the National Ignition Plan, minimal development of NIF target diagnostics and experimental equipment, but delays the initiation of the NIF cryogenic handling system until FY 2001. Funding is included to utilize Omega for 18 weeks of weapons physics experiments by scientists from LANL and LLNL, the same as the FY 1999 level of effort	+27,115
Target Development, Fabrication and Handling	
# Decrease due to completion of the Omega cryogenic handling system and the elimination of direct support for General Atomics cryogenic research and development	-3,835
Laser and Optics Technology Development	
# Decrease due to the completion of NIF optics pilot production	-14,295
Advanced Driver Development	
# Decrease reflecting the need to allocate funds to the higher priority areas in support of NIF ignition	-9,750
Other ICF Support	
# Minimal increase to adequately fund HQ support activities and independent investigator grants	+83
Total, Base ICF Program	-682
National Ignition Facility	
# Decrease for NIF construction (-$36.1 million) and NIF Other Project Costs (-$.9 million) based on the approved funding profile for the project	-37,000
Total Funding Change, Inertial Confinement Fusion	-37,682

Capital Operating Expenses & Construction Summary

Capital Operating Expenses

(dollars in thousands)

	FY 1998	FY 1999	FY 2000	$ Change	% Change
General Plant Projects	1,876	5,550	2,000	-3,550	-64.0%
Capital Equipment	9,856	9,900	10,000	100	1.0%
Total, Capital Operating Expenses	11,732	15,450	12,000	-3,450	-22.3%

Construction Projects

(dollars in thousands)

	Total Estimated Cost (TEC)	Prior Year Approp- riations	FY 1998	FY 1999	FY 2000	Unappro- priated Balance
96-D-111 National Ignition Facility, LLNL	1,045,700	169,300	197,800	284,200	248,100	146,300
Total, Construction		169,300	197,800	284,200	248,100	146,300

Technology Partnerships and Education

Mission Supporting Goals and Objectives

The DP Technology Partnerships program builds cost-shared collaborative R&D partnerships between DP sites and industry. These partnerships were designed to directly support Stockpile Stewardship program objectives by enlisting the expertise and resources of U.S. industry. Defense Programs also provides funding for the Amarillo Plutonium Research Center and the Advanced Computational Technology Initiative (ACTI).

The Education program provides funding to utilize the unique resources of the Department of Energy — people, programs, and facilities -- to improve science and math education throughout the Nation, while supporting the Defense Programs mission. Enhancing the scientific education of our citizens will ensure a highly trained, diverse scientific workforce for the laboratories and will enhance our ability to maintain the scientific and technical expertise necessary to conduct the Stockpile Stewardship mission. The projects, approved by Headquarters and conducted mainly by the Lawrence Livermore National Laboratory, Los Alamos National Laboratory, and Sandia National Laboratories, ongoing in nature or for a defined period, are grouped in six major categories: student support, teacher/faculty enhancement, curriculum improvement, institutional improvement, educational technology and public understanding of science. Each laboratory publishes an annual report on the projects and their accomplishments. Historically Black Colleges and Universities and other minority institutions receive approximately 15 percent of this funding.

Beginning in FY 2000, the Education program will also include funding responsibility transferred from Weapons Program Direction for the Los Alamos County School District to support ongoing education enrichment activities, enhanced teacher salaries and the Northern New Mexico Educational Enrichment Foundation. In addition, funding is requested for the new National Atomic Museum to be located at the Balloon Park Museum in northern Albuquerque, New Mexico.

Performance Measures

Establish strategic alliances and collaborations among the weapons laboratories, industries, and universities to enable effective use of scientific and technical personnel throughout the R&D community.

Funding Schedule

(dollars in thousands)

	FY 1998	FY 1999	FY 2000	$ Change	% Change
Technology Partnerships	55,901	43,072	22,200	-20,872	-48.5%
Education	8,944	9,000	29,800	+20,800	+231.1%
Total, Technology Partnerships and Education	64,845	52,072	52,000	-72	-0.1%

Detailed Program Justification

	(dollars in thousands)		
	FY 1998	FY 1999	FY 2000
Technology Partnerships			
■ In FY 2000, the Technology Partnerships program will continue to work closely with the Advanced Manufacturing, Design and Production Technologies (ADaPT) initiative, Enhanced Surveillance Program, and the Stockpile Stewardship R&D program, though at a reduced level, to ensure partnership activities contribute significantly to the program goals and objectives and the overall DP mission. FY 2000 partnership activities will be focused mainly in two areas: 1) advanced manufacturing, including process technologies, advanced coatings, precision machining and inspection, casting, microelectronics, opto-electronics, forming and joining technologies, computer modeling and simulation robotics, and 2) development of current and potential key suppliers of components and tools (software and hardware), and equipment. Cost shared collaborations have proven the most beneficial, contributing significantly to DP weapons program objectives as well as U.S. competitiveness	35,239	28,072	8,200
■ Support for AMTEX will be discontinued in FY 2000	9,931	7,500	0
■ Support for the Amarillo Plutonium Research Center will be continued in this category (transferred from Weapons Stockpile Management) in FY 2000 with funding up to $5 million	0	0	5,000
■ Support for ACTI will be continued with funding up to $9 million in FY 2000	10,731	7,500	9,000
Total, Technology Partnerships	55,901	43,072	22,200

	(dollars in thousands)		
	FY 1998	FY 1999	FY 2000
Education			
# Provide science and math education programs mainly at the three weapons laboratories, with approximately 15 percent of the funding at Historically Black Colleges and Universities and other minority institutions	8,944	9,000	10,300
# Provide funding for the National Atomic Museum at the new Anderson Abruzzo International Balloon Park Museum (northern end of Albuquerque).	0	0	5,500
Prior to FY 2000, funding for the Los Alamos County School District was requested within Weapons Program Direction. In FY 2000, funding responsibility for these activities has been transferred from Weapons Program Direction in order to combine these activities with other ongoing education programs under the Stockpile Stewardship Education program:			
# In FY 1998, the Department provided $8 million to the School District to support ongoing education enrichment activities and to support enhanced teacher salaries. In FY 1999, Congress appropriated $7 million for the School District; this budget requests up to $8 million for FY 2000	0	0	8,000
# In FY 1998, the Department made the first payment, $3 million, to endow the Northern New Mexico Educational Enrichment Foundation. Per Congressional direction, the Department will provide $25 million to fully endow the Foundation by FY 2002. $3 million was appropriated in FY 1999 and this budget provides a minimum of $6 million for the Northern New Mexico Educational Enrichment Foundation in FY 2000	0	0	6,000
Total, Education	8,944	9,000	29,800
Total, Technology Partnerships and Education	64,845	52,072	52,000

Explanation of Funding Changes from FY 2000 to FY 1999

	FY 2000 vs. FY 1999 ($000)
Technology Partnerships	
■ Funding for partnership activities decreases over 48 percent from FY 1999 appropriation. Many of the ongoing cooperative agreements which began to transition to closeout in FY 1999 will continue to close or may be absorbed within core stockpile stewardship efforts as appropriate	-19,872
■ Support for the American Textile Partnership (AMTEX) will be discontinued in FY 2000	-7,500
■ Support for the Amarillo Plutonium Research Center is transferred to this category from Weapons Stockpile Management in FY 2000	+5,000
■ Up to $9 million will support the Advanced Computational Technology Initiative (ACTI) which will be formulated to provide maximum benefit to weapons programs	+1,500
Total, Technology Partnerships	-20,872
Education	
■ The science and math education programs increases by $1.3 million from the FY 1999 appropriation	+1,300
■ The Education program reflects the transfer of funding responsibility from the Weapons Program Direction decision unit to Stockpile Stewardship Education Programs for continued support for the Los Alamos County School District (up to $8 million) and the Northern New Mexico Educational Enrichment Foundation (a minimum of $6 million). In comparable terms, funding for the School District increases by $1 million from the FY 1999 level, and funding for the Foundation increases by $3 million over the FY 1999 level	+14,000
■ Funding is requested for the new National Atomic Museum to be located at the Balloon Park Museum in northern Albuquerque, New Mexico	+5,500
Total, Education	+20,800
Total Funding Change, Technology Partnerships and Education	-72

00-D-103, Terascale Simulation Facility, Lawrence Livermore National Laboratory, Livermore, California

1. Construction Schedule History

	Fiscal Quarter				Total Estimated Cost ($000)	Total Project Cost ($000)
	A-E Work Initiated	A-E Work Completed	Physical Construction Start	Physical Construction Complete		
FY 2000 Budget Request *(Preliminary Estimate)*	2Q 2000	2Q 2001	4Q 2000	4Q 2004	83,500	86,200

2. Financial Schedule

(dollars in thousands)

Fiscal Year	Appropriations	Obligations	Costs
Design/Construction			
2000	8,000	8,000	7,400
2001	20,000	20,000	19,000
2002	23,000	23,000	22,700
2003	23,000	23,000	23,000
2004	9,500	9,500	11,400

3. Project Description, Justification and Scope

Description

The project provides for the design, engineering and construction of the Terascale Simulation Facility (TSF) which will enable the very large-scale weapons simulations essential to ensuring the safety and reliability of the nuclear weapons stockpile. The building will contain a multi-story office tower with an adjacent computer center designed to house the 100 TeraOPS-class computers needed to meet the requirements of the Stockpile Stewardship Program. The TSF will bring together weapons code development teams to integrate experiments, material, physical, computer, and experimental sciences in support of the Stockpile Stewardship Program. The TSF will also help manage the networks and the "Assessment Theaters" necessary to store and understand the data generated by the most powerful computing systems in the world. The computer and simulation equipment are not funded by this project.

Justification

The Accelerated Strategic Computing Initiative (ASCI) has as its mission the acceleration of terascale simulation to meet the demands of the nation's nuclear defense mission. The challenge is to maintain confidence in the nuclear stockpile without underground nuclear testing. Along with sub-critical experiments, one of the primary tools employed will be three-dimensional (3-D) scientific weapons calculations of unprecedented computational scope. As has been emphasized in the ASCI Program Plan, it is the rapid aging of both the stockpile and the designers with test experience that is at the heart of the issue and the reason for acceleration. The most critical period is between 2003 and 2010. By 2003, the number of designers with test experience will be reduced by about 50 percent from their numbers in 1990. By 2010 the percentage will be further reduced to about 15 percent. By 2003, most of the weapons in the stockpile will be in transition from their designed field life to beyond-field-life design. By 2010, about half will be in the beyond-field-life design stage. Therefore, some validated mechanism or capability must be available soon to certify the safety and reliability of this aging stockpile. A major element of this capability will be the ASCI applications codes and the associated terascale simulation environment. The ASCI program intends over the next six years to reach a threshold state simulation capability in which the first functional "full system calculation" generation of codes requiring a 100-plus TeraOPS computer will be used to certify the stockpile. The remaining designers and analysts with test experience will be an indispensable part of this process, because they will validate the models and simulation results.

The ASCI applications codes and the weapons analysts who make use of these applications require a supporting simulation infrastructure of major proportions, which includes:

- Terascale computing platforms (ASCI Platforms)
- A supporting numerical environment consisting of data management, data visualization and data delivery systems (Stockpile Computing Numerical Environment for Weapons Simulation (NEWS))
- Sophisticated computer science and numerical methods research and development teams (ASCI Problem Solving Environments (PSE) and Alliances)
- A first rate operations, user services and systems team
- Data assessment theaters plus high performance desktop visualization systems

To house, organize and manage these simulation systems and services requires a new facility with sufficient electrical power, mechanical support, networking infrastructure and space for computers and staff. The proposed Terascale Simulation Facility (TSF) at LLNL will meet these requirements.

Scope

The TSF project will construct a building (Building 453) of approximately 270,000 square feet located adjacent to an existing (but far less capable) computer facility, Building 451, on the LLNL main site. The building will contain a multi-story office tower with an adjacent computer center. The computer center will house computer machine rooms totaling approximately 47,500 square feet. The computer machine rooms will be clear span (without impediments) and of an aspect ratio designed to minimize the maximum distance between computing nodes and switch racks. The ceiling height will be sufficiently high to assure proper forced air circulation. A raised access floor will be provided in order to allow adequate room for air circulation, cabling, electrical, plumbing, and leak detection equipment.

The first computer structure will be available for occupancy in 2002. The building will be built with enough power and cooling to support two terascale systems. The first system will likely be installed in 2002. The computer center and electrical rooms will be designed so that power and cooling capacity can be shifted to areas requiring greater or lesser load. As a risk reduction strategy, the building will be further designed so that power and mechanical resources can be easily added in the event that systems sited in the future will require higher levels of power. However, it is expected that after 2004, the rate of growth of the peak capability of installed computers will relax. Therefore, the building should have enough power and cooling to accept any system procured after 2004.

The TSF will include meeting rooms, offices, and a Data Assessment Theater for scientific visualization. The theater will be used both for prototyping advanced visualization concepts and for production. In short, the theater represents that area where physical and computer scientists working together will visualize and make accessible to the human eye and mind the huge data sets generated by the computers. This will allow workers to understand and assess the status of the immensely complex weapons systems being simulated.

The office space will accommodate staff and scientists who require access both to classified and unclassified workstations. Vendors, operational and problem solving environment staff must have immediate access to the computer system, since the simulation environment will require very active support. A key principle underlying all TSF planning is tight coupling between Stockpile Stewardship Program elements and the platforms. Thus, the TSF will also house the nucleus of the classified and unclassified (LabNet) networks. Additionally, space will be available to support a weapons code development team to integrate experimental, physical, material and computer sciences for support of Stockpile Stewardship requirements. To assure the efficient operation of remote Assessment Theaters, high-speed networking hubs will connect the computers seamlessly to key weapons scientists and analysts at the highest performance available.

Project Milestones

FY 2000:	Start design	2Q
	Physical construction start	4Q

4. Details of Cost Estimate

	(dollars in thousands) Current Estimate	Previous Estimate
Design Phase		
Preliminary and Final Design costs (Design Drawings and Specifications - $3,600)	4,715	0
Design Management Costs (0.6% of TEC)	530	0
Project Management Costs (0.6% of TEC)	530	0
Total Design Costs (6.9% of TEC)	5,775	0
Construction Phase		
Improvements to Land	1,700	0
Buildings	46,505	0
Utilities	10,400	0
Standard Equipment	1,255	0
Inspection, Design and Project Liaison, Testing, Checkout and Acceptance	2,940	0
Construction Management (3.2% of TEC)	2,655	0
Project Management (1.8% of TEC)	1,490	0
Total Construction Costs (80.2% of TEC)	66,945	0
Contingencies		
Design Phase (1.1% of TEC)	900	0
Construction Phase (11.8% of TEC)	9,880	0
Total Contingencies (12.9% of TEC)	10,780	0
Total, Line Item Costs (TEC) [a]	83,500	0

5. Method of Performance

Design shall be performed under a negotiated Best Value architect/engineer contract. Construction and procurement shall be accomplished by fixed-price contracts based on competitive bidding and best value.

[a] Escalation rates taken from the FY 2000 DOE escalation multiplier tables.

6. Schedule of Project Funding

(dollars in thousands)

	Prior Years	FY 1998	FY 1999	FY 2000	FY 2001	Outyears	Total
Total project costs							
Total facility costs							
Design	0	0	0	5,500	800	375	6,675
Construction	0	0	0	1,900	18,200	56,725	76,825
Total facility costs (Federal and Non-Federal)	0	0	0	7,400	19,000	57,100	83,500
Other project costs							
Conceptual design costs	0	500	800	0	0	0	1,300
NEPA documentation costs	0	0	150	0	0	0	150
Other project-related costs [b]	0	410	175	0	0	665	1,250
Total other project costs	0	910	1,125	0	0	665	2,700
Total Project Cost (TPC)	0	910	1,125	7,400	19,000	57,765	86,200

7. Related Annual Funding Requirements

(FY 2004 dollars in thousands)

	Current Estimate	Previous Estimate
Related annual costs (estimated life of project--20 years)		
Facility operating costs [c]	1,400	0
Programmatic operating expenses directly related to the facility [d]	53,100	0
Utility costs [e]	8,000	0
Total related annual costs (operating from FY 2004 through FY 2023)	62,500	0

[b] Including tasks such as Project Execution Plan, Pre-Title I Development, Design Criteria, Safeguards and Security Analysis, Architect/Engineer Selection, Value Engineering Study, Independent Cost Estimate, Energy Conservation Report, Fire Hazards Assessment, Site Surveys, Soil Reports, Permits, Administrative Support, Operations and Maintenance Support, ES&H Monitoring, Operations Testing, Energy Management Control System Support, Readiness Assessment.

[c] Facility operating costs are $1,400,000 per year (which also includes facility maintenance and repair costs), when facility is operational in 4th Qtr. FY 2004. Costs are based on the LLNL internal indirect rate Laboratory Facility Charge (LFC) for facility operating costs.

[d] The annual operating expenses for the Terascale Simulation Facility are estimated at $53,100,000 based on representative current operating expenses of 300 personnel. The majority of this funding is expected to come from DOE/DP for activities in support of the Nuclear Weapons Stockpile Stewardship Program.

[e] Costs are based on LLNL utility charges.

00-D-105, Strategic Computing Complex (SCC) Los Alamos National Laboratory, Los Alamos, New Mexico

1. Construction Schedule History

	Fiscal Quarter				Total Estimated Cost ($000)	Total Project Cost ($000)
	A-E Work Initiated	A-E Work Completed	Physical Construction Start	Physical Construction Complete		
FY 2000 Budget Request *(Preliminary Estimate)*	1Q 2000	4Q 2000	1Q 2000	2Q 2002	100,000	106,800

2. Financial Schedule

(dollars in thousands)

Fiscal Year	Appropriations	Obligations	Costs
Design/Construction			
2000	26,000	26,000	22,600
2001	56,000	56,000	59,374
2002	18,000	18,000	18,026

3. Project Description, Justification and Scope

Justification

Without nuclear testing, large-scale computations are the only means of predicting the safety, reliability, and yield of a nuclear weapon. The nuclear stockpile is aging. Generically, aging produces effects that introduce small three-dimensional defects which break the symmetries which designers have invoked in the past when designing nuclear weapons. We are also faced with the issue of the aging of the weapon scientists and engineers that were responsible for developing and testing the weapons in our stockpile. The new simulation models being developed for the stockpile can best be validated by these weapon scientists and engineers. Consequently, greatly enhanced computational requirements in both speed and memory are needed in the near future. It is estimated that assessing the safety and performance of the stockpile will require a factor of 100,000 increase in computational power over what has been required to design new weapons. The Accelerated Strategic Computing Initiative (ASCI), one of the highest priority programs within the Stockpile Stewardship Program, is designed to maintain the safety, reliability, and performance of the nuclear weapons in the stockpile, and is dedicated, and on track, to achieving this goal in less than a decade.

Numerical simulations are now the most important mechanism for the integration of the many complex processes which take place in a thermonuclear weapon. This means that the continued certification of the safety and reliability of the nation's nuclear stockpile relies to a greater extent on computer simulations. To respond to this challenge, the Strategic Computing Complex (SCC) at Los Alamos will be capable of initially supporting a 50 TeraOPS computer platform and be capable of expanding to beyond 150 TeraOPS before 2010. To meet urgent national security requirements associated with nuclear weapons Stockpile Stewardship, this facility must be operational by the 2nd quarter of FY 2002. There is no other facility capable of housing and powering the ASCI supercomputer planned for the SCC.

The SCC and its associated information infrastructure—the high-speed networks, workstations, visualization centers, interactive data-analysis tools and collaborative laboratories—will support the Stockpile Stewardship Program and, potentially, other research efforts involving the simulation of complex phenomena of national importance. The SCC will enable the fulfillment of the prime stewardship mission to ensure the safety, reliability and performance of the Nation's nuclear weapons stockpile without underground nuclear testing. For example, it will be possible to simulate weapons safety scenarios at a multiscale level, beginning with the weapon in its transport container and going through detailed descriptions of components all the way down to the microstructure of the aged high-explosive material.

Description and Scope

The SCC will be a three-story structure with approximately 267,000 gross square feet which will house the world's largest and most capable computer (initially 30 TeraOPS, or 30 trillion floating point operations per second) in a specially designed 43,500-square-foot computer room. This room will be supported by electrical and mechanical rooms in excess of 60,000 square feet.

The facility will provide a dynamic environment for approximately 300 nuclear weapons designers, computer scientists, code developers, and university and industrial scientists and engineers to collaborate to extend the cutting edge of simulation and modeling development in support of nuclear weapons stockpile stewardship requirements. These scientists and engineers will work together, with support personnel, in simulation laboratories (approximately 200 in classified and 100 in unclassified areas). The facility will be located in Technical Area 3 (TA-3) at the Los Alamos National Laboratory.

The SCC features a visualization environment consisting of two immersive theaters, one in the classified area and one in the unclassified area. These theaters will have overhead projection and wrap-around features supporting the latest virtual-reality and visionarium environments. These theaters represent the highest-end capability available for data viewing analysis.

A powerwall theater in the secure environment will provide high-resolution interleaved displays that fill a wall with the latest projection technology. In addition to the powerwall display, this theater will contain conference capability, multiple display monitors, and electronic white-boards to promote effective teaming and collaborative discussions.

A third simulation environment promoting collaborations among teams is supplied by the areas designated as collaboratories. There are four of these areas, and they will contain conference space, a media-stack including laser-disc recorders for animation production and viewing, an immersadesk for compact virtual-reality (VR) analysis, multiple high-resolution graphics heads, electronic white-board, video teleconferencing tools, and electronic collaborative tools for effective interaction with researchers at open and secure sites. The collaboratory provides the users, code developers, and managers with an informal, information- and technology-rich environment with systems for simulation development, collaboration, discussion, media-development, presentation, and problem analysis. The SCC will bring together weapons code development teams to integrate experiments, material, physical computer and experimental sciences in support of the Stockpile Stewardship Program.

An auditorium with seating for approximately 200 people will be provided to serve both classified and unclassified meetings. Conference rooms will be available in the classified and unclassified areas.

The proposed facility concept consists of a three-story structure that includes offices, simulation laboratories, collaboratories, a power wall, and a visualization theater. Site utilities directly related to this facility will be extended and upgraded as necessary.

The mechanical systems will be designed for maximum flexibility. The computer-room cooling system is planned to be adaptable for air-cooled computers, water-cooled computers, or a combination of both types. The simulation laboratory spaces are heated, cooled, and ventilated with modular, variable-volume air handling units, with separate air handling unit systems for classified and unclassified areas. Energy conservation is provided by the use of cooling-tower heat exchangers that are used to meet cooling requirements without running chillers during winter and cooler months.

The SCC facility will be fed by two different 13.8 kV underground power sources and is configured with double-ended switchgear and unit substations to allow switching for maintenance and isolation of faults. The proposed design consists of power conditioners, K-rated transformers, and distribution equipment rated for the high harmonics generated by the computer. The system is modular and expandable to allow growth and easy modification. A grounding ring surrounds the building in addition to a signal reference grid in the computer room to reduce electrical noise. A lightning protection system is incorporated into the facility. A fire detection system will be installed to monitor the entire building, as will a highly sensitive smoke detection system under the computer-raised floor. Communication lines will service the facility through an underground ductbank system utilizing fiber optic cable for both secure and open systems. Copper lines will be used for the voice communication system.

The facility infrastructure is designed to be scalable. At construction completion, the facility will have mechanical and electrical equipment installed to support up to 50 TeraOPS. As requirements go beyond the 50-TeraOPS capability, mechanical and electrical equipment can be added within the building in increments as required to support the computer technology at that time. This scalable feature of the SCC includes future installation of chillers, cooling towers, computer room air-conditioning units, substations, motor-generator power-conditioners, transformers, and panelboards. Scalability provides the Department of Energy (DOE) with a cost-effective option of not installing additional support equipment until it is needed and the ability to capitalize on technological advances in computing technology, as well as in the support equipment.

The computers and simulation equipment to be housed in the SCC are not funded as part of this project, they are funded as part of the ASCI Operations and Maintenance program.

Project Milestones:

FY 2000:	Start Design	1Q

Start Construction	1Q [a]

4. Details of Cost Estimate

	(dollars in thousands) Current Estimate	Previous Estimate
Design Phase		
Preliminary and Final Design costs (Design, Drawings and Specifications - $3,458)	5,665	0
Design Management Costs (0.4% of TEC)	384	0
Project Management Costs (1.0% of TEC)	1,007	0
Total Design Costs (7.1% of TEC)	7,056	0
Construction Phase		
Improvements to Land	971	0
Buildings	56,255	0
Utilities	7,985	0
Standard Equipment	3,717	0
Inspection, Design and Project Liaison, Testing, Checkout and Acceptance	4,170	0
Construction Management (4.3% of TEC)	4,309	0
Project Management (1.5% of TEC)	1,508	0
Total Construction Costs (78.9% of TEC)	78,915	0
Contingencies		
Design Phase (1.5% of TEC)	1,501	0
Construction Phase (12.5% of TEC)	12,528	0
Total Contingencies (14.0% of TEC)	14,029	0
Total, Line Item Costs (TEC) [b]	100,000	0

5. Method of Performance

Design, construction, and procurement will be accomplished by a competitive best value fixed-price design-build contract. Design-build is a project delivery system where a single entity performs both the design and construction. Some advantages of design-build include a single source for construction activities, cost control and accountability.

[a] To meet the proposed completion of the computer room by January 2002, this project will be executed through a design-build contract. Design for grading and onsite utilities will begin in October 1999, physical construction on this aspect of the project will proceed at the end of December 1999, while design on the building continues.

[b] Escalation rates taken from the FY 2000 DOE escalation multiplier tables.

6. Schedule of Project Funding

(dollars in thousands)

	Prior Years	FY 1998	FY 1999	FY 2000	FY 2001	Outyears	Total
Total project costs							
Total facility costs							
Design	0	0	0	8,557	0	0	8,557
Construction	0	0	0	14,043	59,374	18,026	91,443
Total facility costs (Federal and Non-Federal)	0	0	0	22,600	59,374	18,026	100,000
Other project costs							
Conceptual design costs	0	959	1,526	0	0	0	2,485
NEPA documentation costs	0	68	87	44	45	41	285
Other ES&H Costs	0	85	71	11	11	59	237
Other project-related costs [c]	0	758	1,716	121	121	1,077	3,793
Total other project costs	0	1,870	3,400	176	177	1,177	6,800
Total Project Cost (TPC)	0	1,870	3,400	22,776	59,551	19,203	106,800

[c] Project Execution Plan, Pre-Title I Development, Design Criteria, Safeguards and Security Analysis, Design-Build Source Selection Committee work, Value Engineering Study, Independent Cost Estimate, Energy Conservation Report, Fire Hazards Assessment, Site Surveys, Soil Reports, Permits, Administrative Support, Operations and Maintenance Support, ES&H Monitoring, Operations Testing, Energy Management Control System Support, Readiness Assessment.

7. Related Annual Funding Requirements

	(FY 2002 dollars in thousands) Current Estimate	Previous Estimate
Related annual costs (estimated life of project--20 years)		
Facility operating costs [d]	650	0
Facility maintenance and repair costs [e]	1,270	0
Programmatic operating expenses directly related to the facility [f]	55,000	0
Utility costs	6,600	0
Total related annual costs (operating from FY 2002 through FY 2021)	63,520	0

[d] When the facility is operational in the 2nd Quarter of FY 2002, costs will average $650,000 for labor and material per year. An average of 3.0 staff years will be required to operate the facility.

[e] Based on projected annual costs for LANL site services subcontractor as derived from historical maintenance and repair costs for the LDCC facility.

[f] Annual programmatic operating expenses are estimated at $55,000,000 based on representative operating expenses of 300 people. The majority of this funding is expected to come from DOE/DP for activities in support of the Nuclear Weapons Stockpile Stewardship Program.

00-D-107, Joint Computational Engineering Laboratory, Sandia National Laboratories, Albuquerque, New Mexico

1. Construction Schedule History

	Fiscal Quarter				Total Estimated Cost ($000)	Total Project Cost ($000)
	A-E Work Initiated	A-E Work Completed	Physical Construction Start	Physical Construction Complete		
FY 2000 Budget Request *(Preliminary Estimate)*	2Q 2000	2Q 2001	3Q 2001	4Q 2003	28,870	30,303

2. Financial Schedule

(dollars in thousands)

Fiscal Year	Appropriations	Obligations	Costs
Design/Construction			
2000	1,800	1,800	1,500
2001	6,700	6,700	3,261
2002	20,370	20,370	17,748
2003	0	0	6,361

3. Project Description, Justification and Scope

The Joint Computational Engineering Laboratory (JCEL) will be a new, state-of-the-art facility at Sandia National Laboratories for research, development, and application of leading-edge, high-end computational and communications technologies. JCEL will provide office space and laboratories for 175 people in a building with a total of approximately 55,200 gross square feet. JCEL will be the center of Sandia's computational modeling, analysis, and design community, and will be constructed in close proximity to Sandia's existing computer and communications building, presently occupied by part of this community.

JCEL's primary mission is to ensure the rapid development and application of high-end computing, modeling, analysis, and design needed to achieve the objectives of DOE's Stockpile Stewardship Program.

JCEL will utilize key expertise to create strategic simulations and advanced collaborative environments, and it will provide space for strategic partners from universities, DOE Laboratories, and the private sector to work together to integrate the technological expertise of government, universities, and industry. Increased interaction, collaboration, and teamwork are essential for shifting more rapidly to science-based methods and for effective stewardship of the nuclear stockpile. JCEL will provide classified and unclassified space in close proximity to facilitate collaboration between the users of high-end simulation technology and the developers, including research and development partners from universities and industry, while maintaining strict security of classified weapon information. JCEL will also include space designed to encourage interaction and collaboration among the scientists and engineers occupying the building and will provide work space tailored for multidisciplinary, high-performance teams who will develop computer codes and analyze nuclear weapons.

JCEL will provide labs for developing, prototyping and using Virtual Environment Technology, where designers, analysts, and experimenters can interact with each other as if they were in the same room. Moreover, JCEL will use, as well as develop, this leading-edge technology. It will prototype and demonstrate a science and engineering workplace of the 21st century.

The communications networks will enable JCEL's occupants to use the supercomputers in the DOE complex. To display the extensive results of complicated, three-dimensional simulations of nuclear weapons, the JCEL project will also provide computer equipment for virtual reality and advanced visualization techniques, graphics workstations and printers, and video equipment.

To achieve its goals, the JCEL project will provide:

- A facility of approximately 55,200 gross square feet located immediately south of Building 880 in Technical Area I of Sandia National Laboratories on Kirtland Air Force Base in Albuquerque, New Mexico.
- Office space, laboratory space, management and administrative space, and interaction and meeting space.
- Access zones that include controlled, limited-access, and restricted areas.
- Classified and unclassified communications within the facility and between the facility and the rest of Sandia and DOE complex.
- Computer equipment for displaying and printing the results from complex, three-dimensional computer simulations of nuclear weapons.
- Computer workstations for use by engineers and scientists from other DOE labs, universities, and the private sector assigned temporarily to JCEL.
- Video equipment for video conferencing, displaying, and editing video images produced by computer simulations.

Benefits

- Reduced program costs through use of high-fidelity computer simulations developed through JCEL programs to reduce the scope of costly test programs.
- Faster response on stockpile stewardship issues that will arise.
- Rapid interchange of appropriate technology with the external community.
- Accelerated Defense Programs technology development.
- Cost savings in the development of Sandia research foundation technology base through in-kind contributions from industrial partners.

Project Scope

Plan, design, and construct a new, three-story building to accommodate a total of about 175 people, which will provide classified and unclassified space in close proximity. The project will provide computer equipment to: display three-dimensional simulations; support engineers and scientists from other DOE labs, universities, and the private sector, and provide video conferencing capability. Computer equipment includes: Interactive Multimedia equipment ($3,577,500); Virtual Reality/Advanced Visualization equipment ($1,192,500); high-end 3D graphic workstations and printers ($429,300); and design and analysis workstations ($477,000). In addition, the project will move existing furniture and install some new furniture. Site landscaping, parking, pedestrian access improvements, signage, and fencing improvements will be provided.

Project Milestones:

FY 2000: Start Design 2Q

4. Details of Cost Estimate

(dollars in thousands)

	Current Estimate	Previous Estimate
Design Phase		
Preliminary and Final Design costs (Design Drawings and Specifications - $802)	1,604	0
Design Management Costs (0.7% of TEC)	213	0
Project Management Costs (0.6% of TEC)	178	0
Total Design Costs (6.9% of TEC)	1,995	0
Construction Phase		
Improvements to Land	1,056	0
Buildings	12,076	0
Utilities	719	0
Standard Equipment	2,431	0
Major Computer Items	5,676	0
Inspection, Design and Project Liaison, Testing, Checkout and Acceptance	895	0
Construction Management (1.6% of TEC)	463	0
Project Management (0.9% of TEC)	255	0
Total Construction Costs (81.6% of TEC)	23,571	0
Contingencies		
Design Phase (0.9% of TEC)	263	0
Construction Phase (10.5% of TEC)	3,041	0
Total Contingencies (11.5% of TEC)	3,304	0
Total, Line Item Costs (TEC) [a]	28,870	0

[a] Escalation rates taken from the FY 2000 DOE escalation multiplier tables.

5. Method of Performance

Architectural and engineering design and inspection will be performed by Sandia Facilities Departments and/or under a competitive-bid fixed-price contract based on capability and capacity to perform the work. Construction will be performed under a competitive-bid fixed-price contract or multiple competitive-bid fixed-price contracts.

6. Schedule of Project Funding

(dollars in thousands)

	Prior Years	FY 1998	FY 1999	FY 2000	FY 2001	Outyears	Total
Total project costs							
Total facility costs							
Design	0	0	0	1,500	758	0	2,258
Construction	0	0	0	0	2,503	24,109	26,612
Total facility costs (Federal and Non-Federal)	0	0	0	1,500	3,261	24,109	28,870
Other project costs							
Conceptual design cost [b]	989	0	0	0	0	0	989
Other project-related costs [c]	0	159	100	58	35	92	444
Total other project costs	989	159	100	58	35	92	1,433
Total Project Cost (TPC)	989	159	100	1,558	3,296	24,201	30,303

[b] Includes NEPA documentation costs.

[c] Including tasks such as Project Execution Plan, Pre-Title I Development, Design Criteria, Safeguards and Security Analysis, Architect/Engineer Selection, Value Engineering Study, Independent Cost Estimate, Energy Conservation Report, Fire Hazards Assessment, Site Surveys, Soils Reports, Permits, Administrative Support, Operations and Maintenance Support, ES&H Monitoring, Operations Testing, Energy Management Control System Support, Readiness Assessment.

7. Related Annual Funding Requirements

(FY 2003 dollars in thousands)

	Current Estimate	Previous Estimate
Related annual costs (estimated life of project--30 years)		
Facility operating costs [d]	259	0
Facility maintenance and repair costs [e]	118	0
Programmatic operating expenses directly related to the facility [f]	51,000	0
Utility costs	196	0
Total related annual costs (operating from FY 2003 through FY 2032)	51,573	0

[d] When all facilities are operational in the 4th Quarter of FY 2003, average $258,840 for labor and materials per year. An average of 3.4 staff years will be required to operate the facility.

[e] A total of 1.0 staff years per year are required to maintain the facility.

[f] Annual programmatic operating expenses are estimated at $51,000,000, based on representative current operating expenses of 175 people. The majority of this funding is expected to come from DOE/DP for activities in support of the Nuclear Weapons Stockpile Stewardship Program. Lesser amounts are expected from other sources for activities which are mutually beneficial to the funding source and DOE/DP. By bringing these activities together in one building, we expect the effectiveness of this work to be increased by at least 10% and probably much more. This would correspond to a savings of at least $5 million per year of DOE/DP operating funds.

99-D-102, Rehabilitation of the Maintenance Facility, Lawrence Livermore National Laboratory, Livermore, California

(Changes from FY 1999 Congressional Budget Request are denoted with a vertical line [|] in the left margin.)

Significant Changes

Public Law 105–245, the Energy and Water Development Appropriations Act for FY 1999, provided only $15,000,000 of the $25,300,000 requested for new Stockpile Stewardship construction projects, and required independent assessments to validate cost and schedule before initiation of the projects. The independent assessments are targeted to start in the beginning of February with transmission to Congress in early April. Project milestones and funding profiles for this project are consistent with the schedule for completion of the assessments and the Department's implementation of the $10,300,000 FY 1999 funding reduction.

1. Construction Schedule History

	Fiscal Quarter				Total Estimated Cost ($000)	Total Project Cost ($000)
	A-E Work Initiated	A-E Work Completed	Physical Construction Start	Physical Construction Complete		
FY 1999 Budget Request *(Preliminary Estimate)*	1Q 1999	4Q 1999	4Q 1999	3Q 2000	7,900	8,100
FY 2000 Budget Request *(Current Baseline Estimate)*	4Q 1999	2Q 2000	3Q 2000	2Q 2001	7,900	8,100

2. Financial Schedule

(dollars in thousands)

Fiscal Year	Appropriations	Obligations	Costs
Design/Construction			
1999	4,000	4,000	458
2000	3,900	3,900	6,031
2001	0	0	1,411

3. Project Description, Justification and Scope

Building 511 is the mission-critical center of all facility maintenance activity at the Lawrence Livermore National Laboratory (LLNL). In addition to being the center for general facilities maintenance, repair activities, and minor facilities modifications for all facilities at LLNL, the activities conducted in Building 511 include custom manufacture of items essential to experiments conducted in support of the Stockpile Stewardship and Management program and other programs at the lab.

Building 511 is a shop facility that is nearly 60 years old. It will be upgraded and remodeled to make it functional and serviceable for at least the next 20 years, while assuring life safety and operational requirements within the facility. New exterior finish system and window casements will provide a weather-tight building skin. Fire protection and electrical systems will be upgraded as required by code. Rest room facilities will be modified to reflect workplace diversity and to comply with accessibility standards. Entries to the facility will be upgraded for people and for material handling access and egress.

Specifically, this project will accomplish the following:

- Remove and dispose of asbestos siding (28,000 square feet) and install new exterior insulation finishing systems on all exterior faces of the building.
- Replace existing window units and glass (approximately 9,000 square feet).
- Upgrade all existing rest rooms.
- Update fire protection systems including fire exiting requirements, and replace existing fire sprinkler system.
- Replace code deficient and obsolete electrical panels, upgrade electrical receptacles, switches, and grounding.
- Modify building entry to accommodate easy passage of people and material.
- Install an elevator to facilitate movement of people and material to the second floor.

Project Milestones:

FY 1999:	Start Design	4Q
FY 2000:	Complete Design	2Q
	Start Construction	3Q
	Complete construction	4Q

4. Details of Cost Estimate

	(dollars in thousands)	
	Current Estimate	Previous Estimate
Design Phase		
Preliminary and Final Design costs (Design Drawings and Specifications)	800	800
Design Management Costs (0.1% of TEC)	8	0
Project Management Costs (2.6% of TEC)	207	215
Total Design Costs (12.8% of TEC)	1,015	1,015
Construction Phase		
Buildings	4,000	4,000
Inspection, Design and Project Liaison, Testing, Checkout and Acceptance	634	634
Construction Management (5.4% of TEC)	424	424
Project Management (5.7% of TEC)	452	452
Total Construction Costs (69.8% of TEC)	5,510	5,510
Contingencies		
Design Phase (2.8% of TEC)	220	220
Construction Phase (14.6% of TEC)	1,155	1,155
Total Contingencies (17.4% of TEC)	1,375	1,375
Total, Line Item Costs (TEC) [a] [b]	7,900	7,900

5. Method of Performance

Design will be performed by LLNL Plant Engineering. Major equipment requiring long lead time will be purchased by LLNL early in the project on the basis of competitive bidding. To the extent feasible, construction will be accomplished by a fixed-price contract awarded on the basis of competitive bidding. Activation will be performed by LLNL forces.

[a] Escalation rates taken from the FY 1999 DOE escalation multiplier tables.

[b] Current estimate based on Conceptual Design Report of March 1997.

6. Schedule of Project Funding

(dollars in thousands)

	Prior Years	FY 1998	FY 1999	FY 2000	FY 2001	Outyears	Total
Total project costs							
Total facility costs							
Design	0	0	458	777	0	0	1,235
Construction	0	0	0	5,254	1,411	0	6,665
Total facility costs (Federal and Non-Federal)	0	0	458	6,031	1,411	0	7,900
Other project costs							
Conceptual design cost	100	0	0	0	0	0	100
NEPA documentation costs	0	15	0	0	0	0	15
Other project-related costs	50	35	0	0	0	0	85
Total other project costs	150	50	0	0	0	0	200
Total Project Cost (TPC)	150	50	458	6,031	1,411	0	8,100

7. Related Annual Funding Requirements

(FY 2001 dollars in thousands)

	Current Estimate	Previous Estimate
Related annual costs (estimated life of project--20 years)		
Facility operating costs [c]	557	557
Total related annual costs (operating from FY 2001 through FY 2019)	557	557

[c] Facility operating costs are estimated to be $557,000 per year. Costs are based on utility charges and the LLNL internal indirect rate Laboratory Facility Charge for facility operating costs. An average of approximately 6 FTE staff years will be required to operate the facility per year.

99-D-103, Isotope Sciences Facilities, Lawrence Livermore National Laboratory, Livermore, California

(Changes from FY 1999 Congressional Budget Request are denoted with a vertical line [|] in the left margin.)

Significant Changes

Public Law 105–245, the Energy and Water Development Appropriations Act for FY 1999, provided only $15,000,000 of the $25,300,000 requested for new Stockpile Stewardship construction projects, and required independent assessments to validate cost and schedule before initiation of the projects. The independent assessments are targeted to start in the beginning of February with transmission to Congress in early April. Project milestones and funding profiles for this project are consistent with the schedule for completion of the assessments and the Department's implementation of the $10,300,000 FY 1999 funding reduction.

The Total Estimated Cost decreased from $19,400,000 to $17,400,000 and the Total Project Costs decreased from $19,800,000 to $17,700,000 as a result of the following scope reductions:

- The poor condition of 29 exhaust systems required their replacement using operating expense funds prior to the initiation of this project.
- Three HVAC systems in B154 were upgraded by an FY 1998 General Plant Project to satisfy an immediate need for additional laboratory space.

1. Construction Schedule History

	Fiscal Quarter				Total Estimated Cost ($000)	Total Project Cost ($000)
	A-E Work Initiated	A-E Work Completed	Physical Construction Start	Physical Construction Complete		
FY 1999 Budget Request *(Preliminary Estimate)*	1Q 1999	4Q 1999	2Q 2000	2Q 2002	19,400	19,800
FY 2000 Budget Request *(Current Baseline Estimate)*	4Q 1999	1Q 2003 [a]	2Q 2000	2Q 2004	17,400	17,700

[a] Project design and construction components are organized into separate phases with construction on individual phases proceeding upon completion of the design for that phase.

2. Financial Schedule

(dollars in thousands)

Fiscal Year	Appropriations	Obligations	Costs
Design/Construction			
1999	2,000	2,000	100
2000	2,000	2,000	3,700
2001	5,000	5,000	4,500
2002	4,400	4,400	4,400
2003	4,000	4,000	4,000
2004	0	0	700

3. Project Description, Justification and Scope

This project provides for a major rehabilitation of the nuclear chemistry facilities at Lawrence Livermore National Laboratory to extend the life of these essential program facilities. The principle objective of the project is to enhance the radio chemistry research, analytical, and characterization services provided to Defense Programs activities at LLNL. These facilities also support critical analytical waste characterization and programmatic environmental monitoring activities as well.

This project provides for a seismic retrofit and construction of an office addition to the Isotope Science Facility (Building 151), retrofit of Building 151/Building 154 ventilation systems, decontamination of the Refractory Materials Facility (Building 241) and disposal of four existing trailers. The current nuclear chemistry building (B-151) is a 31-year old wet-chemistry research building in need of a major rehabilitation to extend its life in support of the Weapons Stockpile Stewardship Program. The seismic rating of Building 151 does not meet current code requirements. This project will provide the seismic modifications necessary to meet current code requirements for performing isotopic research and support the ongoing mission.

- The Building 151 Office Addition is approximately 22,000 square feet contiguous to B-151. It resolves long standing co-location and program operating efficiency issues in a cost effective package. Exterior treatment will be selected consistent with the existing building, with access provided directly from Building 151 at both floor levels. The addition will contain offices, conference and meeting rooms, elevator, rest rooms, programmatic storage, and various support facilities.

- The existing Building 151 HVAC system is inefficient, difficult to maintain, and does not meet current requirements for exhaust and control. The majority of mechanical work entails taking approximately 51 fume-hood exhaust systems and manifolding them into four new systems. Two air handling units will be converted from constant-volume to variable-air-volume systems with variable-frequency drives. Building 154 is underutilized due to the difficulties in balancing the three air-pressure zones as required by researchers. To fully utilize this building for wet-chemistry laboratory use, the existing HVAC system, retention tank system, utilities, and fire-protection system must be upgraded. The HVAC work done under the FY 1998 General Plant Project corrected some of the HVAC system

| problems, but not all. In addition, approximately 11 new fume hoods with associated exhaust ductwork, fans, and controls will be provided. B-151 and B-154 HVAC modifications and fume hood replacements will rehabilitate these high downtime and high maintenance subsystems and extend life to meet the current mission. Some safety and operational benefits also result.

After moves are completed from Building 241, it will be characterized and decontaminated for future use by Defense Programs at LLNL. Four office trailers will be demolished or excessed to complete the moves. Consolidation of operations from B-241 and personnel from four older trailers complete the efficiency and cost-driven elements, which though minor in cost, have substantial operational benefits.

Along with the seismic retrofit and HVAC system/fume hood replacement, the project encompasses program consolidation for increased efficiency of operations, indirect cost savings, and safety of operations benefits. These are reflected respectively in the B-151 Addition, the B-154 HVAC modifications, and program moves from B-241 and trailers (T-1326, T-1527, T-1927, and T-2425).

| **Project Milestones:**

| FY 1999:	Start Title I Design	4Q
| FY 2000:	Complete Title I Design	3Q
|	Start Title II Design	3Q
|	Start Construction	2Q

4. Details of Cost Estimate

	(dollars in thousands) Current Estimate	Previous Estimate
Design Phase		
Preliminary and Final Design costs (Design Drawings and Specifications -$1,080)	1,350	1,615
Design Management Costs (0.1% of TEC)	20	35
Project Management Costs (0.4% of TEC)	80	80
Total Design Costs (8.3% of TEC)	1,450	1,730
Construction Phase		
Improvements to Land	275	0
Buildings	6,875	10,720
Utilities	155	0
Standard Equipment	940	0
Removal Cost Less Salvage	2,160	170
Inspection, Design and Project Liaison, Testing, Checkout and Acceptance	785	930
Construction Management (6.3% of TEC)	1,100	1,370
Project Management (2.9% of TEC)	505	990
Total Construction Costs (73.5% of TEC)	12,795	14,180
Contingencies		
Design Phase (1.4% of TEC)	235	260
Construction Phase (16.8% of TEC)	2,920	3,230
Total Contingencies (18.2% of TEC)	3,155	3,490
Total, Line Item Costs (TEC) [b]	17,400	19,400

The Current Estimate is based on the Conceptual Design Report of March 1997 and the supplement dated April 1998.

5. Method of Performance

Contracting arrangements are as follows: Design will be performed by A-E and LLNL forces. Major equipment requiring long lead time will be purchased by LLNL early in the project on the basis of competitive bidding. To the extent feasible, construction will be accomplished by a fixed-price contract awarded on the basis of competitive bidding. Activation will be performed by LLNL forces.

[b] Escalation rates taken from the FY 1999 DOE escalation multiplier tables.

6. Schedule of Project Funding

(dollars in thousands)

	Prior Years	FY 1998	FY 1999	FY 2000	FY 2001	Outyears	Total
Total project costs							
Total facility costs							
Design	0	0	100	750	590	245	1,685
Construction	0	0	0	2,950	3,910	8,855	15,715
Total facility costs (Federal and Non-Federal)	0	0	100	3,700	4,500	9,100	17,400
Other project costs							
Conceptual design cost	150	0	0	0	0	0	150
NEPA documentation costs	0	25	0	0	0	0	25
Other project-related costs	0	75	0	0	0	50	125
Total other project costs	150	100	0	0	0	50	300
Total Project Cost (TPC)	150	100	100	3,700	4,500	9,150	17,700

7. Related Annual Funding Requirements

(FY 2004 dollars in thousands)

	Current Estimate	Previous Estimate
Related annual costs (estimated life of project--20 years)		
Facility operating costs	740	704
Total related annual costs (operating from FY 2004 through FY 2023)	740	704

99-D-104, Protection of Real Property (Roof Reconstruction—Phase II), Lawrence Livermore National Laboratory, Livermore, California

(Changes from FY 1999 Congressional Budget Request are denoted with a vertical line [|] in the left margin.)

Significant Changes

Public Law 105–245, the Energy and Water Development Appropriations Act for FY 1999, provided only $15,000,000 of the $25,300,000 requested for new Stockpile Stewardship construction projects, and required independent assessments to validate cost and schedule before initiation of the projects. The independent assessments are targeted to start in the beginning of February with transmission to Congress in early April. Project milestones and funding profiles for this project are consistent with the schedule for completion of the assessments and the Department's implementation of the $10,300,000 FY 1999 funding reduction.

1. Construction Schedule History

	Fiscal Quarter				Total Estimated Cost ($000)	Total Project Cost ($000)
	A-E Work Initiated	A-E Work Completed	Physical Construction Start	Physical Construction Complete		
FY 1999 Budget Request *(Preliminary Estimate)*	1Q 1999	1Q 2000	3Q 1999 [a]	4Q 2001	19,900	19,930
FY 2000 Budget Request *(Current Baseline Estimate)*	3Q 1999	2Q 2003	4Q 1999 [b]	4Q 2003	19,900	19,970

[a] Design and construction was planned as three separate packages (Package 1: 4 buildings; Package 2: 3 buildings; Package 3: 4 buildings). Construction on Package 1 will begin while design of Package 2 is still ongoing.

[b] Design and construction will now be handled as five separate packages (Package 1: 2 buildings; Package 2: 2 buildings; Package 3: 1 building; Package 4: 2 buildings; Package 5: 4 buildings). Construction on each package will begin upon completion of the design for that package, while design continues on the remaining packages.

2. Financial Schedule

(dollars in thousands)

Fiscal Year	Appropriations	Obligations	Costs
Design/Construction			
1999	2,500	2,500	1,608
2000	2,400	2,400	3,176
2001	2,800	2,800	2,689
2002	2,800	2,800	2,900
2003	9,400	9,400	7,836
2004	0	0	1,691

3. Project Description, Justification and Scope

This project is the second of three phases of the LLNL roof replacement program. The first Phase is funded under 96-D-102. Phase II addresses 11 Weapons Stockpile Stewardship and Management Program buildings which require complete roofing system replacement along with the replacement of associated roof mounted equipment and piping systems which have deteriorated beyond economical repair. This is required in order to maintain and protect the integrity of the facilities and to assure that programmatic work can proceed without the risk of serious damage to the buildings or the programmatic efforts contained within. Work includes buildings: B111, B113, B121, B141, B194, B231, B241, B251, B281, B321 and B332. In all cases, the roofing systems have exceeded their 20 year design life by 11 to 23 years. The same holds true for most of the roof mounted equipment and piping systems as they are original equipment, again with an average design life of 20 years. Both the roofing and mechanical systems have deteriorated to the point where normal repair is no longer a viable alternative.

The 11 roofs in this project are experiencing severe deterioration problems including membrane failure, and the associated roof mounted mechanical equipment is also showing high levels of unreliable operation which adversely effect the support to the programmatic effort. As stated, normal maintenance procedures no longer are effective to maintain weather integrity of the roofing systems, to the point that leaks in the roofing system are jeopardizing experiments, experimental data and equipment. The impact from not replacing the roofing and mechanical equipment systems will result in excessive maintenance and repairs costs. In addition, the adverse programmatic impact could cost the Lab and Defense Programs significant dollars in lost production.

Operating expense budgets fund maintenance at a level of required repair, but not at the level required to replace roofs and roof mounted mechanical equipment. Since these 11 buildings are required to support critical Weapons Stockpile Stewardship and Management Program missions, capital funding is requested for the replacement of the roofs and associated roof mounted mechanical equipment.

| **Project Milestones:**

| FY 1999: Package No. 1 (Buildings 111 and 194)

Start Design	3Q
Complete Design	4Q
Start Construction	4Q

| FY 2000: Complete Construction Package No. 1 — 1Q

| Package No. 2 (Buildings 332, 251, and 121)

Start Design	1Q
Complete Design	2Q
Start Construction	3Q
Complete Construction	4Q

4. Details of Cost Estimate

(dollars in thousands)

	Current Estimate	Previous Estimate
Design Phase		
Preliminary and Final Design costs (Design Drawings and Specifications - $640)	770	770
Design Management Costs (0.1% of TEC)	29	29
Project Management Costs (0.3% of TEC)	50	50
Total Design Costs (4.3% of TEC)	849	849
Construction Phase		
Other Structures	9,000	9,000
Standard Equipment	3,810	3,810
Inspection, Design and Project Liaison, Testing, Checkout and Acceptance	2,183	2,183
Construction Management (2.2% of TEC)	444	444
Project Management (4.2% of TEC)	844	844
Total Construction Costs (81.8% of TEC)	16,281	16,281
Contingencies		
Design Phase (1.0% of TEC)	207	207
Construction Phase (12.9% of TEC)	2,563	2,563
Total Contingencies (13.9% of TEC)	2,770	2,770
Total, Line Item Costs (TEC) [c]	19,900	19,900

[c] Escalation rates taken from FY 1999 DOE escalation multiplier tables. Current estimate based on Conceptual Design Report of March 1997.

5. Method of Performance

The Laboratory proposes a new approach to the implementation of this project. The new approach includes obtaining the services of a roofing specialist to develop construction contractor specifications and perform construction management and inspection. The construction contract is planned to be a unit price based contract with standard construction details. Change order processing and negotiations will be greatly simplified. This new approach should greatly reduce the cost of engineering and design. Minor architect-engineer work and activation will be performed by LLNL forces.

6. Schedule of Project Funding

(dollars in thousands)

	Prior Years	FY 1998	FY 1999	FY 2000	FY 2001	Outyears	Total
Total project costs							
Total facility costs							
Design	0	0	100	262	466	228	1,056
Construction	0	0	1,508	2,914	2,223	12,199	18,844
Total facility costs (Federal and Non-Federal)	0	0	1,608	3,176	2,689	12,427	19,900
Other project costs							
Conceptual design costs	30	0	0	0	0	0	30
Other project-related costs	0	40	0	0	0	0	40
Total other project costs	30	40	0	0	0	0	70
Total Project Cost (TPC)	30	40	1,608	3,176	2,689	12,427	19,970

7. Related Annual Funding Requirements

(FY 2003 dollars in thousands)

	Current Estimate	Previous Estimate
Related annual costs (estimated life of project--20 years)		
Total related annual costs (operating from FY 2003 through FY 2022)	0	0

99-D-105, Central Health Physics Calibration Facility, Los Alamos National Laboratory, Los Alamos, New Mexico

(Changes from FY 1999 Congressional Budget Request are denoted with a vertical line [|] in the left margin.)

Significant Changes

Public Law 105–245, the Energy and Water Development Appropriations Act for FY 1999, provided only $15,000,000 of the $25,300,000 requested for new Stockpile Stewardship construction projects, and required independent assessments to validate cost and schedule before initiation of the projects. The independent assessments are targeted to start in the beginning of February with transmission to Congress in early April. Project milestones and funding profiles for this project are consistent with the schedule for completion of the assessments and the Department's implementation of the $10,300,000 FY 1999 funding reduction.

1. Construction Schedule History

	Fiscal Quarter				Total Estimated Cost ($000)	Total Project Cost ($000)
	A-E Work Initiated	A-E Work Completed	Physical Construction Start	Physical Construction Complete		
FY 1999 Budget Request *(Preliminary Estimate)*	1Q 1999	3Q 1999	1Q 2000	1Q 2001	3,900	4,200
FY 2000 Budget Request *(Current Baseline Estimate)*	3Q 1999	2Q 2000	2Q 2000	2Q 2001	3,900	4,200

2. Financial Schedule

(dollars in thousands)

Fiscal Year	Appropriations	Obligations	Costs
Design/Construction			
1999	2,900	2,900	1,197
2000	1,000	1,000	2,203
2001	0	0	500

3. Project Description, Justification and Scope

The purpose of this project is to consolidate all of the existing health physics calibration functions at LANL in one location. The location will be remote from the general public due to the radiation present when calibrating instruments. The facility will allow calibration of radiation protection instruments to the required levels for: x-rays, beta and alpha contamination, gamma-rays, tritium, and neutrons.

The equipment and sources currently used for the radiation detector calibrations are over 30 years old in almost all cases. Source drive mechanisms have exceeded their useful lives. If an equipment failure or a source rupture occurs (due to old age), the mission of the Laboratory could be severely compromised. Without appropriate health physics instruments in place, facilities could be shut down because of the possibility of compromised worker radiation protection.

The current facilities are scattered among three areas: the Calibration Building, TA-3-130; and the upper floor and two basement areas of the Physics Building, TA-3-40. A number of Physics Division personnel are located in the same building and close to the ESH-4 Calibration Laboratory at TA-3-40. Operations at the Calibration Laboratory can cause low level radiation exposures to these personnel. These exposures are not As-Low-As-Reasonably Achievable (ALARA). The operators of the existing calibration equipment are also subject to radiation fields due to the configuration of the radiation sources. These exposures would be eliminated with operations moved to a refurbished facility.

The LANL Radiation Instrument Calibration (RIC) function is a very important institutional program. Approximately 8,000 instruments are maintained, repaired, and calibrated each year. These include portable and fixed alpha/beta contamination monitors, exposure rate meters, tritium-in-air monitors, continuous air monitors, and stack effluent monitors. Effluent monitor results are reported to the Environmental Protection Agency (EPA). The calibrations performed have a significant link to the radiation worker health and safety.

This newly renovated facility will allow the calibration functions to meet the requirements of 10 CFR 835, Occupational Radiation Protection; DOE Order 5480.4 - Environmental protection, Safety and Health Protection, which requires compliance with ANSI N323 - Radiation Protection Instrument Test and Calibration, and ANSI N42.17 - Performance Specifications for Health Physics Instrumentation, and will enable the laboratory to close a Tiger Team Category II finding.

The site selected, TA-36 Building 1, is currently occupied by a group performing administrative functions and very low level radiation experiments. The current occupants would be moved to another location. The TA-36 site is remote from the densely populated areas of the Laboratory, is served by paved roads, and is located in a secure area. The building (approximately 100,000 square feet) will be renovated, additional shielding installed for the calibration function, and renovated for all functions associated with radiological calibration. One smaller structure will be constructed at TA-36 by the project. The structure, Building 214, will be approximately 2,380 square feet and will house two free in air calibration functions that require high bay facilities. This building will be a concrete structure due to shielding requirements. The remote, refurbished site would eliminate the problems outlined above. The calibrations would be performed using state-of-the-art equipment, minimizing the probability of failure and the consequent threat to the Laboratory mission. The operator exposure would be eliminated as well. The ALARA concerns would no longer be an issue.

| **Project Milestones:**

FY 1999:	Start Design	3Q
FY 2000:	Complete Design	2Q
	Start Construction	2Q

4. Details of Cost Estimate

	(dollars in thousands)	
	Current Estimate	Previous Estimate
Design Phase		
Preliminary and Final Design costs (Design Drawings and Specifications)	208	208
Design Management Costs (0.5% of TEC)	20	20
Project Management Costs (0.3% of TEC)	10	10
Total Design Costs (6.1% of TEC)	238	238
Construction Phase		
Improvements to Land	55	55
Buildings	1,310	1,310
Special Equipment	1,225	1,225
Standard Equipment	210	210
Removal Costs Less Salvage	70	70
Inspection, Design and Project Liaison, Testing, Checkout and Acceptance	42	42
Construction Management (1.5% of TEC)	58	58
Project Management (0.8% of TEC)	32	32
Total Construction Costs (77.0% of TEC)	3,002	3,002
Contingencies		
Design Phase (2.3% of TEC)	90	90
Construction Phase (14.6% of TEC)	570	570
Total Contingencies (16.9% of TEC)	660	660
Total, Line Item Cost (TEC) [a]	3,900	3,900

5. Method of Performance

Design and inspection will be performed under a negotiated architect-engineer fixed-price contract. Construction of the project will be accomplished by a fixed-price contracts and subcontracts awarded on the basis of competitive bidding.

[a] Escalation rates taken from the FY 1999 DOE escalation multiplier tables.

6. Schedule of Project Funding

(dollars in thousands)

	Prior Years	FY 1998	FY 1999	FY 2000	FY 2001	Outyears	Total
Project costs							
Facility costs							
Design	0	0	197	131	0	0	328
Construction	0	0	1,000	2,072	500	0	3,572
Total facility costs (Federal and Non-Federal)	0	0	1,197	2,203	500	0	3,900
Other project costs							
Conceptual design costs	100	30	0	0	0	0	130
NEPA documentation costs	20	40	0	0	0	0	60
Other project-related costs	30	30	30	20	0	0	110
Total other project costs	150	100	30	20	0	0	300
Total project cost (TPC)	150	100	1,227	2,223	500	0	4,200

7. Related Annual Funding Requirements

(FY 2001 dollars in thousands)

	Current Estimate	Previous Estimate
Related annual costs (estimated life of project--30 years)		
Facility Operating Costs	30	30
Facility Maintenance and Repair Costs	20	20
Utility Costs	12	12
Total related annual costs (operating from FY 2001 through FY 2030)	62	62

99-D-106, Model Validation and Systems Certification Center, Sandia National Laboratories, Albuquerque, New Mexico

(Changes from FY 1999 Congressional Budget Request are denoted with a vertical line [|] in the left margin.)

Significant Changes

Public Law 105–245, the Energy and Water Development Appropriations Act for FY 1999, provided only $15,000,000 of the $25,300,000 requested for new Stockpile Stewardship construction projects, and required independent assessments to validate cost and schedule before initiation of the projects. The independent assessments are targeted to start in the beginning of February with transmission to Congress in early April. Project milestones and funding profiles for this project are consistent with the schedule for completion of the assessments and the Department's implementation of the $10,300,000 FY 1999 funding reduction.

1. Construction Schedule History

	Fiscal Quarter				Total Estimated Cost ($000)	Total Project Cost ($000)
	A-E Work Initiated	A-E Work Completed	Physical Construction Start	Physical Construction Complete		
FY 1999 Budget Request *(Preliminary Estimate)*	2Q 1999	2Q 2000	3Q 2000	4Q 2001	18,219	19,111
FY 2000 Budget Request *(Current Baseline Estimate)*	3Q 1999	4Q 2000	3Q 2000	4Q 2002	18,230	19,122

2. Financial Schedule

(dollars in thousands)

Fiscal Year	Appropriations	Obligations	Costs
Design/Construction			
1999	1,600	1,600	720
2000	6,500	6,500	6,064
2001	5,200	5,200	5,927
2002	4,930	4,930	5,519

3. Project Description, Justification and Scope

The Department of Energy (DOE) has the statutory and mission responsibility for the design, production, maintenance, retirement and dismantlement of the United States nuclear weapons. In support of this mission, Defense Programs is responsible for the engineering development of the nonnuclear components and the overall systems engineering and integration for all nuclear weapons, including the integration of nuclear weapons with their delivery vehicles. Responsibilities also include assuring that weapons' military characteristics (MCs) and Stockpile-to-Target-Sequence (STS) requirements are met for hostile, normal, and abnormal environments.

Pertinent, reliable, and timely information is key to fulfilling these responsibilities, and in part, this information is obtained through laboratory testing and corresponding analysis. Testing is performed in five primary areas in support of nonnuclear components and systems:

- Development testing (testing to certify design intent)
- Experimentation to validate and certify analytical models
- Product certification (such as neutron generators and AT 400 containers)
- Surveillance testing, which sometimes includes investigative testing
- Testing to support dismantlement.

Confidence in certifying the stockpile has been and will continue to be contingent upon high-quality, reliable, and pertinent data and competent analysis of that data, although the approach to obtain and analyze data and the nature of the data will change in response to DOE stockpile stewardship challenges.

The Model Validation and Systems Certification Center (MVSCTC) Project will provide a modern communications infrastructure coupled with a common control/operations facility for Sandia's eleven full-scale environmental test capabilities located in Tech Area III. The concept design of the MVSCTC reflects an optimized operational system composed of three subsystems including: Communications Infrastructure, Command and Control, and facilities to accommodate related operational functions.

The MVSCTC Project will implement an operational system that allows for both remote and local control of each of the test capabilities. This system will allow for more effective and efficient management of test operations and provide flexibility in meeting programmatic and specific customer needs. The Command and Control Center (CCC) will provide the remote control; Mobile Interface Units (MIUs) will provide local data acquisition and command and control as well as connection to the communications infrastructure at the individual test capabilities.

The MVSCTC communications infrastructure will be comprised of a communications hub (the CCC) and supporting infrastructure (communications media from the CCC to each of the test sites) that will link Sandia's environmental test capabilities to other Sandia personnel involved in modeling, simulation, design and related activities. Additionally, the infrastructure will link the MVSCTC into the nuclear weapons complex (NWC) electronic information network. The communications infrastructure will consist of high-capacity cabling installed in an underground concrete-encased ductbank of conduits. The capacity and robust nature of this infrastructure protection assures not only the viability of the communications infrastructure over the long run but also allows advances in communications technology to be easily incorporated over the life of the system.

Two MIUs, which are self-contained mobile trailers that house the equipment necessary to control the test capabilities and collect data from them, will be used for local control of test capability and to interface the communications system to nine of the eleven test capabilities. (Two test capabilities have unique programmatic needs that require connection to the communications system at all times.) Shared use of these two MIUs to support nine test facilities standardizes and reduces the equipment that is otherwise required at each of the test facilities. The MIUs are being built as part of Sandia's Modernization Program; only the purchase and installation of the pertinent communications infrastructure termination equipment to be placed in the MIU as part of the MVSCTC is included in this capital project request.

Facilities to Accommodate Related Operational Functions

The scope of the proposed project will include the rehabilitation of two existing buildings, Buildings 6584 and 6587. A small addition will be constructed on the southwest corner of Building 6584 to accommodate a new entry ramp and lobby for the Command and Control Center. Included in the scope is 15,200 square feet of Building 6584 (circa 1950) and 4,700 square feet in the west end of Building 6587 (circa 1950). Existing occupants will be relocated to accommodate the MVSCTC.

Special Facilities

Communications Infrastructure

The communications infrastructure is the overall system of fiber-optic and copper lines and related infrastructure elements. To provide needed communications capacities, an unspliced 72 fiber cable will be installed from the CCC to each test capability. Use of unspliced runs assures longevity of the infrastructure and maximum information transmission capacity.

In addition to the fiber-optic cable, copper lines consisting of 30 pairs of telephone cable and 15 pairs of individually-shielded instrumentation cable will be installed. The telephone cable provides 24-hour service to each test capability for telephone, fire, and intrusion systems.

All fiber-optic and copper lines will be installed in a PVC ductbank, placed in a trench and encased in concrete. The depth of the concrete encased ductbank will be 30-inches below grade. Associated manholes and/or junction boxes will be locked.

The proposed communications infrastructure is located primarily within Sandia's Tech Area III. However, the main fiber optic trunk, which is to be installed from the existing Tech Control Center (TCC) in the Technology Support Center (TSC, Building 6585) to the MVSCTC, extends beyond the Tech Area III borders. The TSC is located just outside Tech Areas III and V, approximately 400 linear feet from the MVSCTC common control facility in Building 6584. The Tech Control Center (TCC) in the TSC will provide the point of physical connection into existing telecommunications infrastructure.

Planned connection to the existing copper telephone infrastructure will occur at a location close to the TSC (specifically, Building 6585A containing an optical remote) or at an additional trunk breakout location near the Centrifuge Facility, Building 6526. The actual connection point will depend on modifications that Sandia is presently making to the telephone infrastructure.

Command/Control System

The command and control system includes all the electronic systems required to manage the communications systems, interface the information systems to the test capabilities and allow operators, engineers, and customers to control capability functions and observe and record operations. Electronic equipment required to perform these functions includes: digital network and video switching and transmission hardware; computer systems; video display and recording systems;

and hardcopy peripherals. The majority of this equipment will be located in the CCC. Hardware required for the communications network completion at the test site or in the MIUs is also included in the MVSCTC Project scope.

| **Project Milestones:**

FY 1999:	Start Design	3Q
FY 2000:	Complete Design	4Q
	Start Construction	3Q

4. Details of Cost Estimate

	(dollars in thousands) Current Estimate	Previous Estimate
Design Phase		
Preliminary and Final Design costs (Design Drawings and Specifications -$691)	938	938
Design Management Costs (1.3% of TEC)	238	238
Project Management Costs (0.7% of TEC)	122	122
Total Design Costs (7.1% of TEC)	1,298	1,298
Construction Phase		
Improvements to Land	227	227
Buildings	2,907	2,907
Special Equipment	8,586	8,586
Standard Equipment	1,473	1,473
Inspection, Design and Project Liaison, Testing, Checkout and Acceptance	422	422
Construction Management (2.1% of TEC)	381	381
Project Management (0.8% of TEC)	154	154
Total Construction Costs (77.6% of TEC)	14,150	14,150
Contingencies		
Design Phase (1.2% of TEC)	213	213
Construction Phase (14.1% of TEC)	2,569	2,558
Total Contingencies (15.3% of TEC)	2,782	2,771
Total, Line Item Costs (TEC) [a]	18,230	18,219

5. Method of Performance

This work will be accomplished using a Sandia administered fixed-price, incentive, design-build contract.

[a] Escalation rates taken from the FY 1999 DOE escalation multiplier tables. Current estimate based on Conceptual Design Report dated March 12, 1997.

6. Schedule of Project Funding

(dollars in thousands)

	Prior Years	FY 1998	FY 1999	FY 2000	FY 2001	Outyears	Total
Project costs							
Facility costs							
Design	0	0	720	564	227	0	1,511
Construction	0	0	0	5,500	5,700	5,519	16,719
Total facility costs (Federal and Non-Federal)	0	0	720	6,064	5,927	5,519	18,230
Other project costs							
Conceptual design costs	306	0	0	0	0	0	306
NEPA documentation costs	20	0	0	0	0	0	20
Other ES&H costs	0	0	6	14	14	14	48
Other project-related costs	10	72	106	98	110	122	518
Total other project costs	336	72	112	112	124	136	892
Total Project Cost (TPC)	336	72	832	6,176	6,051	5,655	19,122

7. Related Annual Funding Requirements

(FY 2002 dollars in thousands)

	Current Estimate	Previous Estimate
Related annual costs (estimated useful life of each facility--40 years)		
Facility operating costs [b]	141	141
Facility maintenance and repair costs [c]	818	818
Programmatic operating expenses directly related to the facility [d]	5,733	5,733
Capital equipment not related to construction but related to the programmatic effort in the facility	235	235
Utility costs	77	77
Total related annual costs (operating from FY 2002 through FY 2041)	7,004	7,004

[b] Facility operating costs will average $127,000 for labor and $14,000 for materials per year. An average of 1.7 staff years will be required to operate all facilities. The facility does not replace any other facility.

[c] Maintenance and repair costs for all facilities average $348,000 for labor and $470,000 for materials. A total of 5 staff years per year is required to maintain all facilities.

[d] Estimate reflects annual programmatic operating expenses associated with the operations and maintenance of the eleven test capabilities that are to be connected through the communications infrastructure to the common command and control facility implemented by the MVSCTC. Estimate includes: all loaded labor associated with direct test activities as well as preventative maintenance; facility costs (space charges, direct purchases, service contracts, etc.) and associated overhead loads. Estimate also includes projected, annualized operating expenditures incurred to maintain, repair, or replace-in-kind the existing equipment in these test capabilities.

99-D-108, Renovate Existing Roadways, Nevada Test Site

(Changes from FY 1999 Congressional Budget Request are denoted with a vertical line [|] in the left margin.)

Significant Changes

Public Law 105–245, the Energy and Water Development Appropriations Act for FY 1999, provided only $15,000,000 of the $25,300,000 requested for new Stockpile Stewardship construction projects, and required independent assessments to validate cost and schedule before initiation of the projects. The independent assessments are targeted to start in the beginning of February with transmission to Congress in early April. Project milestones and funding profiles for this project are consistent with the schedule for completion of the assessments and the Department's implementation of the $10,300,000 FY 1999 funding reduction.

1. Construction Schedule History

	Fiscal Quarter				Total Estimated Cost ($000)	Total Project Cost ($000)
	A-E Work Initiated	A-E Work Completed	Physical Construction Start	Physical Construction Complete		
FY 1999 Budget Request *(Preliminary Estimate)*	1Q 1999	4Q 1999	1Q 2000	1Q 2001	11,005	11,128
FY 2000 Budget Request *(Current Baseline Estimate)*	3Q 1999	1Q 2000	2Q 2000	1Q 2001	11,005	11,128

2. Financial Schedule

(dollars in thousands)

Fiscal Year	Appropriations	Obligations	Costs
Design/Construction			
1999	2,000	2,000	1,021
2000	7,005	7,005	6,002
2001	2,000	2,000	3,982

3. Project Description, Justification and Scope

This project will provide for the renovation of 37.0 miles of Mercury Highway from the southern boundary of the Nevada Test Site (NTS) to the intersection of Rainier Mesa Road to Area 3. These repairs will consist of removing existing debris from pavement cracks, filling cracks with asphalt sealant, installing a stress absorbing membrane, and applying a new asphaltic-concrete overlay. In addition, the 2.3 miles of the Rainier Mesa Road from the intersection of Mercury Highway to the intersection of road

4-04 in Area 4 will be reconstructed. Repairs will consist of total reconstruction of the roadbed and the application of the asphalt pavement.

The renovated road will have two-inch-thick overlay; the reconstructed road will have three-inch-thick paving. Aggregate shoulders will parallel each side. All required traffic signs, striping, and markers will be included in this project. No buildings or utilities are included in this project.

Mercury Highway is the primary access highway for any activity at the NTS, including subcritical experiments and future missions. This all-weather, paved, asphaltic-concrete road has been in service for almost 40 years. All personnel, heavy equipment, and supplies entering and/or exiting the NTS depend upon this access route. The pavement surface has severely deteriorated because of age, ground motion from underground nuclear events, and heavy truck traffic. Trucks frequently carry loads that far exceed normal highway limits, i.e., H-20 highway wheel-loading. Standard remedial measures, such as crack-filling or chip-and-seal overlays, will do little to extend the road's service life. The proposed extensive renovation will both eliminate the pavement distress as well extend the road's service life.

The Rainier Mesa Road is the only access road to the ongoing Big Explosive Experiment Facility (BEEF) in Area 4. This road is now extensively damaged. Total reconstruction of this road is required to continue use as a viable access road in support of the BEEF program.

Project Milestones:

FY 1999:	Start Design	3Q
FY 2000:	Complete Design	1Q
	Start Construction	2Q

4. Details of Cost Estimate

	(dollars in thousands) Current Estimate	Previous Estimate
Design Phase		
Preliminary and Final Design costs (Design Drawings and Specifications)	1,332	1,332
Design Management Costs (0.7% of TEC)	85	85
Project Management Costs (1.7% of TEC)	189	189
Total Design Costs (14.6% of TEC)	1,606	1,606
Construction Phase		
Improvements to Land	6,924	6,924
Inspection, Design and Project Liaison, Testing, Checkout and Acceptance	72	72
Construction Management (4.9% of TEC)	534	534
Project Management (2.5% of TEC)	270	270
Total Construction Costs (70.9% of TEC)	7,800	7,800
Contingencies		
Design Phase (2.5% of TEC)	273	273
Construction Phase (12.0% of TEC)	1,326	1,326
Total Contingencies (14.5% of TEC)	1,599	1,599
Total, Line Item Cost (TEC) [a]	11,005	11,005

5. Method of Performance

Design will be performed by the performance-based management contractor. To the extent feasible, construction and procurement will be accomplished by fixed-price contracts and subcontracts awarded on the basis of competitive bidding. Inspection, contract administration, surveying, and related project functions will be accomplished by the performance-based management contractor.

[a] Escalation rates taken from the FY 1999 DOE escalation multiplier tables.

6. Schedule of Project Funding

(dollars in thousands)

	Prior Years	FY 1998	FY 1999	FY 2000	FY 2001	Outyears	Total
Project costs							
Facility costs							
Design	0	0	1,021	828	30	0	1,879
Construction	0	0	0	5,174	3,952	0	9,126
Total facility costs (Federal and Non-Federal)	0	0	1,021	6,002	3,982	0	11,005
Other project costs							
Conceptual design costs	92	0	0	0	0	0	92
NEPA documentation costs	26	0	0	0	0	0	26
Other project-related costs	5	0	0	0	0	0	5
Total other project costs	123	0	0	0	0	0	123
Total project cost (TPC)	123	0	1,021	6,002	3,982	0	11,128

7. Related Annual Funding Requirements

(FY 2001 dollars in thousands)

	Current Estimate	Previous Estimate
Related annual costs (estimated life of project--35 years)		
Total related annual costs (operating from FY 2001 through FY 2035)	0	0

97-D-102, Dual-Axis Radiographic Hydrodynamic Test Facility (DARHT), Los Alamos National Laboratory, Los Alamos, New Mexico

(Changes from FY 1999 Congressional Budget Request are denoted with a vertical line [|] in the left margin.)

Significant Changes

None.

1. Construction Schedule History

	Fiscal Quarter				Total Estimated Cost ($000)	Total Project Cost ($000)
	A-E Work Initiated	A-E Work Completed	Physical Construction Start	Physical Construction Complete		
FY 1988 Budget Request	1Q 1988	N/A [a]	4Q 1988	4Q 1990	30,000	N/A [b]
FY 1989 Budget Request	3Q 1988	N/A [a]	4Q 1988	4Q 1990	53,400	N/A [b]
FY 1990 Budget Request	3Q 1988	N/A [a]	4Q 1988	4Q 1992	53,400	N/A [b]
FY 1991 Budget Request	3Q 1988	N/A [a]	2Q 1989	4Q 1992	53,400	N/A [b]
FY 1992 Budget Request	3Q 1988	1Q 1995	2Q 1989	4Q 1994	53,400	N/A [c]
FY 1993 Budget Request	3Q 1988	1Q 1995	2Q 1989	4Q 1994	53,400	N/A [c]
FY 1994 Budget Request	3Q 1988	1Q 1995	2Q 1989	3Q 1997	81,400	85,600
FY 1995 Budget Request	3Q 1988	4Q 1995	2Q 1989	3Q 1997	81,400	85,600
FY 1996 Budget Request	3Q 1988	4Q 1995	2Q 1989	3Q 1998	81,400	85,600
FY 1997 Budget Request	3Q 1988	4Q 1995	3Q 1989	1Q 1999	105,700	114,760
FY 1998 Budget Request	3Q 1988	4Q 1995	3Q 1989	1Q 1999	186,700	199,210
FY 1999 Budget Request	3Q 1988	4Q 2000	3Q 1989	4Q 2002	259,700	269,800
FY 2000 Budget Request *(Current Baseline Estimate)* [d]	3Q 1988	4Q 2000	3Q 1989	4Q 2002	259,700	269,800

[a] There was no requirement for A-E duration or completion date during these fiscal years and, therefore, this information is not available.

[b] There was no requirement for TPC during these fiscal years and, therefore, this information is not available.

[c] During these fiscal years, the project was delayed while completing the Accelerator Development Plan in order to verify plans and budgets and, therefore, this information is not available.

[d] Due to the complicated history of this project as described in Section 3, and the fact that it has two distinct phases, it is not possible to identify the specific year for Preliminary Estimate and Title I Baseline.

2. Financial Schedule [e]

(dollars in thousands)

Fiscal Year	Appropriations	Obligations	Costs
Design/Construction			
1988	1,800	1,800	201
1989	9,700	9,700	2,912
1990	10,905 [f]	10,905	10,767
1991	5,000 [g]	5,000	7,558
1992	0	0	5,139
1993	3,500 [h]	3,500	2,643
1994	17,000	17,000	5,881
1995	17,000	3,000	6,159
1996	16,495	19,495	5,045
1997	0	11,000	23,873
1998	46,300 [i]	46,300	37,681
1999	36,000	36,000	47,809
2000	61,000	61,000	59,341
2001	35,000	35,000	32,106
2002	0	0	12,585

3. Project Description, Justification and Scope

The Dual-Axis Radiographic Hydrotest Facility (DARHT) project was previously a subproject of the Nuclear Weapons Research, Development, and Testing Facilities Revitalization, Phase II project (88-D-106). With the virtual completion of the remaining ten subprojects in 88-D-106, the DARHT effort was established as a stand-alone project in FY 1997 so that it can be more readily managed, monitored and funded.

Justification

Since its inception in 1988, the DARHT project has been recognized as a key link in DOE efforts to maintain the quality and reliability of the nuclear weapons stockpile. Historically, radiographic hydrodynamic tests and dynamic experiments have been a requirement to support the DOE (and

[e] Funds appropriated in FY 1988-1996 are from the DARHT subproject 88-D-106 and were moved to 97-D-102 to support management and monitoring of the project.

[f] Reflects an appropriation of $15,760,000 and the subsequent sequestration of $4,855,000 for FY 1990 and the FY 1990 Omnibus reprogramming approved by appropriations subcommittees.

[g] Reflects an appropriation of $16,800,000 and the subsequent FY 1991 Omnibus reprogramming of $11,800,000 approved by Congressional subcommittee.

[h] No funds were appropriated in FY 1993. Reflects reprogramming of $3,500,000 redirected from prior year appropriation from Dormitories subproject of Line Item 88-D-106 at the Nevada Test Site (NTS).

[i] FY 1998 funding represents $24,300,000 for completion of Phase 1 (first-axis) and $22,000,000 for engineering planning and long-lead procurement for Phase 2.

predecessor agencies) mission; they remain an important requirement for future efforts of the Stockpile Stewardship and Management (SS&M) Program as they assist in the understanding and evaluation of nuclear weapon performance. Dynamic experiments are used to gain information on the physical properties and dynamic behavior of materials used in nuclear weapons, including changes due to aging. Hydrodynamic tests are used to obtain diagnostic information on the behavior of a nuclear weapons primary (using simulated materials for the fissile materials in an actual weapon) and to evaluate the effects of aging on the nuclear weapons remaining in the greatly reduced stockpile. The information that comes from these types of tests and experiments cannot be obtained in any other way.

The DOE existing capability to obtain diagnostic information was designed and implemented at a time when the organization could rely on direct observations of the results of underground nuclear tests to provide definitive answers to questions regarding nuclear weapons performance. Without the ability to verify weapons performance through nuclear tests, the remaining diagnostic tools are inadequate by themselves to provide sufficient information. Accordingly, as the Nation moves away from nuclear testing, DOE must enhance its capability to use other tools to predict weapons safety, performance, and reliability. In particular, DOE must enhance its capability to perform hydrodynamic experiments to assess the condition and behavior of nuclear weapons primaries.

Although the current U.S. stockpile is considered to be safe and reliable, the existing weapons are aging beyond their initial design lifetimes and, by the turn of the century, the average age of the stockpile will be older than at any time in the past. To ensure continued confidence in the safety and reliability of the U.S. nuclear weapons stockpile, DOE needs to improve its radiographic hydrodynamic testing capability as soon as possible. Uncertainty in the behavior of the aging weapons in the enduring stockpile will continue to increase with the passage of time because existing testing techniques, by themselves, are not adequate to assess the safety, performance, and reliability of the weapons primaries. Should DOE need to repair or replace any age-affected components, retrofit existing weapons, or apply new technologies to existing weapons, existing techniques are not adequate to assure weapons safety and reliability. In an era without nuclear testing, DOE believes that it is probable that the existing weapons will require these types of repairs or retrofits in the foreseeable future. DOE has determined that no other currently available advanced techniques exist that could provide a level of information regarding nuclear weapons primaries comparable to that which could be obtained from enhanced radiographic hydrodynamic testing.

In addition to weapons work, DOE uses its radiographic testing facilities to support many other science missions, and needs to maintain or improve its radiographic testing capability for this purpose. Hydrodynamic tests and dynamic experiments are important tools for evaluating conventional munitions; for studying hydrodynamics, materials physics, and high-speed impact phenomena; and for assessing and developing techniques for disabling weapons produced by outside interests.

Project History Leading to Current Project Scope

Originally, the project scope included two 16-MeV electron-beam accelerators producing x-rays. In FY 1990, the Department decided to defer construction of the Hydrotest Firing Site (HFS) pending completion of technology development verified by the test results from an Integrated Test Stand (ITS), which consisted of about 30 percent of one x-ray machine. Following the successful ITS test results, development and construction of the hydrotest firing site was re-scoped based on the recommendations of two independent "Blue Ribbon" review committees assembled to assist the Department of Energy (DOE) in enhancing the development of a vital hydrotest capability. The new scope provided for the development, procurement, and installation of the first of two 16-MeV flash x-ray machines (for dual-axis radiography) at the firing site; and construction of a weatherproof building to house the dual-axis radiographic systems and supporting calibration activities. Construction was resumed in FY 1994.

On January 26, 1995, an injunction was issued for this project by the United States District Court for the District of New Mexico, requiring a cessation of all actions associated with the DARHT construction project, including any construction, procurement, design, or any furtherance of the DARHT project pending completion and judicial review of an Environmental Impact Statement (EIS) and Record of Decision (ROD). In response, the Department ceased all project activities and completed an EIS for the project. A ROD was published in October 1995. The preferred option that was selected was to complete the project and operate the DARHT facility with the use of steel containment vessels to minimize the environmental impacts from operation of the facility. This containment option includes multiple phases to eventually obtain at least 75 percent reduction in the emissions from high-explosives testing when compared to the DARHT Baseline Alternative analyzed in the EIS. The January 1995 injunction was lifted in April 1996 and DARHT construction resumed in May 1996.

The DARHT project is now redefined to comply with the ROD preferred alternative and is divided into two phases. The first phase, most of which has been in progress since FY 1988, consists of the construction of a Radiographic Support Laboratory (RSL) and a Hydrotest Firing Site (HFS), which includes the first of two flash x-ray machines. In addition, this phase includes: the initial stage of containment of emissions from the high-explosives experiments to be conducted at the facility; an increase in accelerator energy from 16 to 20 MeV; changes in the accelerator to generate higher electron-beam currents; and improved diagnostics. Phase 1 will be completed during FY 1999 and the first axis will become operational by June 1999. Phase 2 will include the second flash x-ray machine, as well as the second stage of increased containment of testing emissions. The Department's decision in September 1997 of the Long-Pulse Induction Accelerator as the best technology for the second axis resulted in the current baseline for the project. A third phase of increased containment of testing emissions as defined in the ROD will be evaluated after several years of operating experience on DARHT. If a decision is made at the time to develop a vessel system capable of containing a 400 pounds of TNT equivalent high explosives, a new line item would be proposed.

Phase 1

Phase 1 provides for the construction of the Radiographic Support Laboratory, which is completed; development, procurement, and installation of the first of two flash x-ray machines (for dual-axis radiography) at the firing site; procurement and installation of state-of-the-art hydrodiagnostic instrumentation at the firing site; construction of a blastproof building to house the dual-axis radiographic systems and support calibration activities; and, the first containment vessel (an existing vessel design modified for DARHT testing).

Hydrotest Firing Site (HFS)

The entire HFS building is being constructed as part of this phase, as well as the first x-ray machine and all electronic and optical diagnostics. The second machine, necessary to complete the essential dual-axis configuration of the facility, will be built in a sequential manner (Phase 2), allowing it to take advantage of engineering and scientific advances that occur before its construction. The first machine is a state-of-the-art linear induction accelerator, producing an electron beam of approximately 20-MeV that will be converted into an x-ray beam. A high speed electronic data acquisition system, a firing site control system, and optical imaging systems will also be included. Optical instrumentation includes high-speed framing and streak cameras and laser velocity interferometers. To improve the diagnostics capability of this facility, a gamma-ray camera is included.

The HFS building is a two-level, 39,650-square-foot building to house and operate both accelerators. The walls and roof are designed to shield personnel operating the facility from the radiation produced by the accelerators, as well as to resist blast forces resulting from the detonation of explosives. The accelerators will be located on a three foot thick concrete slab on grade. Both accelerator rooms contain a total of approximately 13,175 square feet and are equipped with a 10-ton capacity bridge crane. Completion of the entire building for both x-ray machines allows installation of the second machine (Phase 2) to take place without stopping hydrodynamic testing activities that would begin upon installation of the first machine.

The power supply rooms provide space adjacent to the accelerators for electrical equipment that serves the accelerators. These rooms are equipped with 3-ton capacity bridge cranes. The detection chamber is electromagnetically shielded. Adjacent to the detection chamber are the control room, a cable room, a capacitor discharge unit (CDU) room, and a computer room. The detection chamber, computer room and accelerator control room are also provided with an access flooring system. Other rooms include an optical room, an analyzer room, a Fabry Perot room, a laser illumination room, an assembly room, toilets, and mechanical/electrical equipment room. This area contains approximately 26,475 square feet.

Fire protection is provided throughout by a hydraulically designed foam/water automatic sprinkler system. Plumbing and process piping includes hot and chilled circulating water, potable hot and cold water, industrial cool water, sanitary sewer, compressed air, natural gas, transformer oil, and low-conductivity water systems. A boiler and two chillers are included to provide hot and cold water. This conditioned water is used for heating, ventilating, and air-conditioning the building, with the exception of the detection chamber and accelerator control room, which are serviced with "computer-type" units. Two above-ground, 12,000 gallon oil storage tanks, a cooling tower, and an electrical substation are provided. Power is supplied to the building from an existing 13.2 kV line. The building is equipped with communication systems that include telephone, intercom, and broad band communications.

Site work includes a new asphalt surfaced access road, an asphalt surfaced circulation road and parking area, surface drainage, and erosion control. Utilities extended to the site include natural gas, water, electrical power, and communication services. A septic tank and seepage pit are provided to handle the sanitary sewage.

For Phase 1, a prototype vessel system and a temporary cleanout unit are being fabricated to obtain the initial 5 percent reduction in testing emissions when compared to the DARHT Baseline Alternative analyzed in the EIS for the first five-year period of facility operation. The prototype vessel system will be a modification of an existing steel vessel design for experiments containing up to 27 kg of high-explosives.

Phase 2

Included in DARHT Phase 2 is the second electron beam accelerator which will be installed in the second accelerator hall provided in Phase 1. The second machine, necessary to complete the essential dual-axis configuration of the facility, is being built in a sequential manner, allowing it to take advantage of engineering and scientific advances that have occurred since construction of the first machine. In September 1997, the Department selected the Long-Pulse Linear Induction Accelerator because it presented the greatest technological advancement for the lowest cost and least risk. The second machine will be capable of providing four high-quality beam pulses over four microseconds with each pulse comparable in quality to the single pulse machine in the first axis.

The technology selected for Phase 2 requires a machine that is longer than the accelerator hall currently under construction. To accommodate the longer machine, it was necessary to increase the size of the west accelerator hall by 1,300 square feet. Other modifications that were required to the HFS included a larger roof hatch to install equipment, extension of the 3-foot thick accelerator foundation and glycol system modifications. While the HFS was constructed as part of Phase 1, the changes were driven by Phase 2 requirements and were, therefore, budgeted for in Phase 2.

A preparation facility includes high bay space for cleanout, process, and two staging areas. The high bay spaces will include bridge cranes. This facility includes a small analytical lab, change rooms, storage, waste storage, fabrication shop, a small multipurpose room, an area for office cubicles, and the mechanical/electrical support spaces.

Fire protection for the vessel preparation facility will be provided throughout by a hydraulically designed automatic sprinkler system. Areas with the potential for contamination will drain to a 25,000 gallon above-ground storage tank to provide secondary containment of the sprinkler water. The areas with the potential for contamination will also be connected to a mitigating debris recycling system. Other plumbing systems will be potable hot and cold water, hot and cold circulating water, a double wall drain line for potentially contaminated water, and sanitary waste drainage. A natural gas-fired boiler will provide the hot water and a chiller will provide the chilled water. The HVAC system will include a HEPA filtration system to vent the vessels. The areas with potential contamination will be designed for seven air changes per hour with a once-through air handling system. The analytical lab will be equipped with a fume hood. The building will be equipped with communication systems that will include telephone, intercom, and broad-bank communications.

Site work for the vessel preparation facility will include a new asphalt surfaced access road, a large asphalt paved circulation and parking area. The circulation area will be designed for the large vessel handling equipment and storage. There will also be approximately 2,000 square feet of covered storage. Utilities extended to the site will include natural gas, water, sanitary sewer, electrical power, and communication services. Power will be supplied to the building from an existing 13.2-kV line.

This phase includes a vessel capable of containing a detonation of 124 pounds of TNT equivalent high explosives and a vessel capable of confining a detonation of 44 pounds of TNT equivalent high explosives. This results in a reduction in testing emissions of at least 40 percent, when compared to the DARHT Baseline Alternative analyzed in the EIS, during the second 5-year period of facility operation. Containment goals will be met or exceeded through the use of a combination of techniques: containment, material replacement, post-shot recovery, and program management.

Experience gained during Phases 1 and 2 will allow the final containment techniques to be implemented that would result in at least 75 percent reduction in testing emissions when compared to the DARHT Baseline Alternative analyzed in the EIS for the remaining years of facility operation. The Department of Energy will meet the release reduction goals of this phase through the use of the combination of techniques discussed above.

| **Project Milestones:**

FY 1999:	Phase 1:	HFS Construction Complete	3Q
		First Axis Machine Operational	3Q
		Complete First Axis Readiness Assessment	3Q
	Phase 2:	Deliver Accelerator Cells to LANL for Prototype Testing with the Beam	4Q
FY 2000:	Phase 1:	Complete	
	Phase 2:	Complete Second Axis Machine Accelerator Hardware Design	1Q
		Complete Confinement Vessel Design	2Q
		Complete Design for Vessel Preparation Facility	4Q

4. Details of Cost Estimate*

(dollars in thousands)

Phase 1	Current Estimate	Previous Estimate
Design Phase		
Preliminary and Final Design costs (Design Drawings and Specifications)	23,959	23,959
Total Design Costs (22.7% of TEC)	23,959	23,959
Construction Phase		
Buildings	23,814	23,814
Special Equipment	46,804	46,804
Inspection, Design and Project Liaison, Testing, Checkout and Acceptance	2,032	2,032
Project Management (6.1% of TEC)[j]	6,439	6,439
Total Construction Costs (74.8% of TEC)	79,089	79,089
Contingencies		
Construction Phase (2.5% of TEC)	2,652	2,652
Total Contingencies (2.5% of TEC)	2,652	2,652
Total, Line Item Costs (TEC)	105,700	105,700

*Note: The Details of Cost Estimate section has been split between Phase 1 and Phase 2 to more accurately reflect costs under the categories required for the FY 2000 budget. It is not possible to identify all costs in the new categories since this project was established and tracked using cost categories in effect at the time of initial funding in FY 1988.

[j] Since the project was initially funded in FY 1988, all of the Phase 1 management effort has been tracked only as project management; consequently, all design and construction management is included as project management under the construction phase.

4. Details of Cost Estimate

(continued)

Phase 2	Current Estimate (dollars in thousands)	Previous Estimate (dollars in thousands)
Design Phase		
Preliminary and Final Design Costs (Design Drawings and Specifications)	17,337	17,337
Design Management Costs (0.2% of TEC)[k]	273	273
Project Management Costs (0.2% of TEC)[k]	382	382
Total Design Costs (11.7% of TEC)	17,992	17,992
Construction Phase		
Buildings	9,370	9,370
Special Equipment	101,103	101,593
Inspection, Design and Project Liaison, Testing, Checkout and Acceptance	336	336
Construction Management (0.4% of TEC)[k]	637	637
Project Management (5.7% of TEC)[k]	8,832	8,832
Total Construction Costs (78.1% of TEC)	120,278	120,768
Contingencies		
Design Phase (1.9% of TEC)	2,902	2,902
Construction Phase (8.3% of TEC)	12,828	12,338
Total Contingencies (10.2% of TEC)	15,730	15,240
Total, Line Item Costs (TEC)[l] (Phase 2)	154,000	154,000
Total, Line Item Costs (TEC) (Phase 1)	105,700	105,700
Total, Line Item Costs (Phase 1 and Phase 2)	**259,700**	**259,700**

5. Method of Performance

Design and procurement of the conventional facilities were performed under negotiated architect-engineer contracts. To the extent feasible, construction and procurement will be accomplished by fixed-price contracts and subcontracts awarded on the basis of competitive bidding.

[k] Design and construction management only includes conventional facility design and construction. Design phase project management includes only conventional facility design phase management. Construction Phase project management includes both the conventional facility construction phase management and all of the special equipment project management. Special equipment does not have a traditional construction component with design, procurement and installation taking place concurrently among the various special equipment work elements. Attempting to separately track and report special equipment design and construction management would require establishing an additional 26 WBS elements and associated cost control elements. This is deemed to have greater cost than benefit. The intent to establish conventional facility construction design and construction management costs is supported, however, in this approach.

[l] Escalation rates taken from FY 1999 DOE escalation multiplier tables.

6. Schedule of Project Funding

(dollars in thousands)

	Prior Years*	FY 1998	FY 1999	FY 2000	FY 2001	Outyears	Total
Total project costs							
Total facility costs							
Design	20,239	10,004	6,568	3,999	2,039	2,004	44,853
Construction	49,939	27,677	41,241	55,342	30,067	10,581	214,847
Operating expense funded equipment	1,105	0	0	0	0	0	1,105
Total facility costs (Federal and Non-Federal)	71,283	37,681	47,809	59,341	32,106	12,585	260,805
Other project costs							
R&D necessary to complete construction	1,471	0	0	0	0	0	1,471
Conceptual design cost	260	0	0	0	0	0	260
NEPA documentation costs	2,960	0	0	0	0	0	2,960
Other project-related costs [m]	2,795	8	461	0	0	1,040	4,304
Total other project costs	7,486	8	461	0	0	1,040	8,995
Total Project Cost (TPC)	78,769	37,689	48,270	59,341	32,106	13,625	269,800

7. Related Annual Funding Requirements

(FY 2002 dollars in thousands)

	Current Estimate	Previous Estimate
Related annual costs (estimated life of project--30 years)		
Facility operating costs [n]	10,400	10,400
Programmatic operating expenses directly related to the facility [o]	8,000	8,000
Total related annual costs (operating from FY 2002 through FY 2031)	18,400	18,400

[m] These are the costs for (1) FY 1997 Technology Options Study to evaluate the alternative technologies for the second x-ray machine, (2) facility start-up including the Readiness Assessment, and (3) management of operating expense items.

[n] These are all direct and indirect costs associated with maintaining the facility readiness for programmatic purposes. It includes facility maintenance, utility costs, space tax, organizational support, janitorial services, and security with both axes operational and in the final containment phase. It includes the RSL, HFS, and Vessel Preparation Facility. On average, the related effort is 28.5 FTEs.

[o] The annual programmatic operating expense will fluctuate significantly from year to year depending on the programmatic effort. The $8,000,000 is an average based on the FY 1997 effort at PHERMEX.

96-D-102, Nuclear Weapons Stockpile Stewardship Facilities Revitalization, Phase VI, Various Locations

(Changes from FY 1999 Congressional Budget Request are denoted with a vertical line [|] in the left margin.)

Significant Changes

Reduced FY 1999 funding for new Stockpile Stewardship construction projects, and the resulting impacts to FY 2000 and outyear funding profiles, have required reprioritization of outyear Stockpile Stewardship funding requirements. As a result, the funding profile for the Storm Drain, Sanitary Sewer, and Domestic Water subproject at Sandia National Laboratories has been adjusted. By the end of FY 2000, the project will complete the Sanitary Sewers, Water System Meters and Controls, and the 9th Street Storm Drain System. No funding will be requested in FY 2001, and when funding resumes in FY 2002, the project will start and complete Water Systems Rehabilitation and complete the remainder of the Storm Drain portion of this subproject.

1. Construction Schedule History

	Fiscal Quarter				Total Estimated Cost ($000)	Total Project Cost ($000)
	A-E Work Initiated	A-E Work Completed	Physical Construction Start	Physical Construction Complete		
FY 1996 Budget Request [a]	1Q 1996	1Q 1999	3Q 1997	4Q 1999	33,700	34,660 [a]
FY 1997 Budget Request	1Q 1996	4Q 1999	3Q 1997	1Q 2002	69,659	70,748
FY 1998 Budget Request	1Q 1996	4Q 1999	3Q 1997	1Q 2002	72,876	75,475
FY 1999 Budget Request	1Q 1996	4Q 1999	3Q 1997	4Q 2000	74,226	76,254
FY 2000 Budget Request *(Current Baseline Estimate)*	1Q 1996	3Q 2002	3Q 1997	4Q 2003	74,226	76,298

[a] The TEC/TPC for this project in FY 1996 includes only two subprojects. Additional subprojects were included in the FY 1997 (two) and FY 1998 (two) Construction Project Data Sheets bringing the total number of subprojects funded within this line item to six.

2. Financial Schedule

(dollars in thousands)

Fiscal Year	Appropriations	Obligations	Costs
Design/Construction			
1996	2,520	2,520	340
1997	19,250	19,250	3,744
1998	19,810	19,810	21,470
1999	24,106 [b]	24,106	28,679
2000	2,640	2,640	12,802
2001	0 [b]	0	1,291
2002	2,900	2,900	1,900
2003	3,000	3,000	4,000

3. Project Description, Justification and Scope

This series of projects provides for the construction of new facilities, and modifications, relocations, and additions to existing facilities for the Nuclear Weapons Stockpile Stewardship facilities at Sandia National Laboratories (SNL), Los Alamos National Laboratory (LANL), Lawrence Livermore National Laboratory (LLNL) and the Nevada Test Site (NTS). These projects are a multiyear capital investment program to revitalize the Nuclear Weapons Stockpile Stewardship complex. These facilities will replace or add to existing facilities and infrastructure that are overaged, deteriorated, overcrowded, or are inadequate to preserve capabilities required for the current and future weapons stockpile stewardship program.

The Nuclear Weapons Stockpile Stewardship program is made up of a highly complex set of activities which are extremely dependent on current and advanced technology facilities and equipment to meet its varied needs. The successful performance of the Stockpile Stewardship program contributes directly to the quality and reliability of the nuclear weapons stockpile. In addition to unremitting requirements for reliability and performance, we are committed to pursue new safety and safeguards features for the enduring stockpile. These standards require innovative physics concepts and designs, the development of new materials and material applications, and extension of both engineering and manufacturing technologies beyond the current "state-of-the-art." All of this requires support of a reliable infrastructure.

The revitalization effort was initiated in FY 1984 with Project 84-D-107, Nuclear Testing Facilities Revitalization, and was followed in FY 1985, FY 1988, FY 1990, FY 1992 and FY 1994 by follow-on phases. These projects were defined based on needs identified by representatives from the Albuquerque and Nevada Operations Offices, and the three weapons laboratories. Since the initiation of these projects,

[b] A reprogramming action that received final Congressional approval on November 5, 1998, increased FY 1999 funding for the 138 kV Substation Modernization subproject by $3,683,000 and eliminated the corresponding FY 2001 funding requirement.

all aspects of the laboratory complex capital asset base continued to be critically reviewed and have resulted in the initiation of this line item project which contains six subprojects.

The consolidation of the Nuclear Weapons Stockpile Stewardship revitalization needs into one project data sheet focuses the issue of the total needs of the Stockpile Stewardship program. With the decreased demand for new weapon systems, this project is oriented toward preserving the critically needed infrastructure at LANL, NTS, SNL, and LLNL. These subprojects all cover general purpose facilities at various DOE locations that are an integral part of the installation support infrastructure. Included are basic utility systems, such as electrical power distribution, sewage, roads, parking lots, gas distribution, water supply, and the like. Many of these systems were constructed during the 1940s to World War II specifications with a 10-year maximum life expectancy. Despite extensive preventative maintenance over the intervening years, many of them are now deteriorated beyond economic repair and do not meet present-day standards for safety and environmental protection.

Full funding for subprojects 01, Water Well Replacements; 02, Fire Protection Improvements; 04, Roof Replacement; and 06, Site 300 Fire Station/Medical Facility has been provided through prior year appropriations.

Details for subprojects 03, 138 kV Substation Modernization; and 05, Storm Drain, Sanitary Sewer, and Domestic Water Systems, Modernization, which require funding in FY 2000 are provided.

Subproject 01 - Water Well Replacements, LANL, Los Alamos, New Mexico

TEC	Previous	FY 1998	FY 1999	FY 2000	FY 2001	Outyears	Construction Start - Completion Dates
$16,800	$11,200	$ 4,500	$ 1,100	$ 0	$ 0	$ 0	3Q 1997 - 4Q 1999

This project received its final funding in FY 1999. No additional funding is required.

Project Milestones:

FY 1999:	Complete Construction for Phase B	3Q
	Complete Construction for Phase C	4Q
FY 2000:	Start of Operations	2Q

Subproject 02 - Fire Protection Improvements, LANL, Los Alamos, New Mexico

TEC	Previous	FY 1998	FY 1999	FY 2000	FY 2001	Outyears	Construction Start - Completion Dates
$16,900	$ 6,570	$ 5,450	$ 4,880	$ 0	$ 0	$ 0	4Q 1997 - 4Q 1999

This project received its final funding in FY 1999. No additional funding is required.

Project Milestones:

FY 1999: Complete Construction	4Q
FY 2000: Start of Operations	3Q

Subproject 03 - 138kV Substation Modernization, NTS, Las Vegas, Nevada

TEC	Previous	FY 1998	FY 1999	FY 2000	FY 2001	Outyears	Construction Start - Completion Dates
$ 11,992	$ 1,000	$ 2,667	$ 6,350 [c]	$ 1,975	$ 0 [c]	$ 0	4Q 1997 - 4Q 2000

This project will modernize one major substation (Frenchman Flat Substation), one switching center (Mercury Switching Center), and one tap station (Valley Tap) on the 138 kilovolt (kV) transmission system loop at the Nevada Test Site (NTS). It will also provide for the installation of a SCADA fiber-optics communication loop. The Mercury Switching Center serves as a termination point for the incoming power line from Nevada Power Company (NPC).

No major site improvements are proposed for the modernized facilities except possible site and access road grading.

Frenchman Flat Substation (FF), Canyon Substation (CA), Mercury Switching Center (MSC), and Valley Tap (VAT) will each require modifications to the control buildings. Each building will provide an adequate environment for electrical relays, switchgear, breaker control panels, and telecommunications equipment. Each control building will contain a heating, ventilation, and air conditioning HVAC system; a fire detection and alarm system; electrical power for interior and exit lighting; battery-powered emergency lighting; telephones; and fully insulated walls and ceilings. The substation, switching center and tap station will employ new gas breaker technology, microprocessor relays, supervisory control and data acquisition (SCADA) control of major equipment, and new SCADA fiber-optic cable for telecommunication requirements (relaying, metering, and telephone system).

The Frenchman Flat Substation is an important part of the overall NTS power system and feeds critical loads associated with laboratories' activities.

The Mercury Switching Center is the termination point for the NPC 138 kV transmission line, which provides the primary power source to the NTS. NPC metering is also located at this facility.

The Valley Tap Switchstation will be a relaying point on the 138 kV transmission loop to allow proper sectionalizing of the loop during fault conditions. This will maintain most of the users in service including Systems which accounts for over a third of the NTS power usage.

A SCADA fiber-optics loop will enhance or upgrade the existing communications system. This fiber-optics loop will employ approximately 115 miles of fiber-optic cable wrapped around the existing overhead static wire on the NTS 138 kV transmission line.

The 138 kV transmission loop with its associated facilities is the backbone of the entire NTS power system. Reliable power for all weapons testing programs, future missions, the Yucca Mountain Project,

[c] A reprogramming action that received final Congressional approval on November 5, 1998, increased FY 1999 funding by $3,683,000 and eliminated the FY 2001 funding requirement.

environmental programs, and many other projects and programs conducted at the NTS are dependent upon the reliability of these facilities. Maintenance of aging and failing equipment is becoming increasingly more difficult because many replacement parts are no longer available. The Mercury Switching Center is a key substation at the NTS and connects to the outside utility company (NPC), which provides electrical power to the site. Equipment failures in these facilities have a significant impact upon all NTS programs and the reliability of the entire power system.

Existing 138 kV power facilities at the NTS are approximately 28 to 38 years old. The substation and switching center to be modernized in this project are among some of the oldest facilities at the NTS. Over the past several years increased outages due to equipment failure have occurred on a more frequent basis and will continue to accelerate until replaced.

The existing power line carrier communications system used for supervisory control has been in service long past its useful life span, is obsolete and unreliable. Current power line carrier replacement projects have improved the communication capability as a stop gap measure only, using old existing fiber-optic cables and borrowed microwave facilities. When the new SCADA fiber-optic loop is installed, it will provide adequate speed and capacity for modern relaying, SCADA, and metering facilities. A new communications loop using fiber-optics technology is the most practical solution to provide a long-term, reliable communication system for the NTS power system.

This project is needed in order to avoid future high maintenance expenses and frequent power interruptions that the NTS has experienced during critical times, to reduce the risk of serious or fatal injuries to the workers who maintain the deteriorating system, and to enable NTS activities to activate its readiness capability, if called upon.

Project Milestones:

FY 1999:	Complete design and start construction on the SCADA fiber-optic communication loop	3Q
	Complete design and start construction on the 138 kV relay grades	4Q
	Start design for replacing circuit switchers at VAT and FF	4Q
FY 2000:	Complete construction of the SCADA fiber-optic communications loop	1Q
	Start design modifications for MSC transfer bus	2Q
	Complete design and start construction for replacing circuit switchers at VAT and FF	3Q
	Complete construction on the 138 kV relay upgrades	4Q
	Complete design and start construction on MSC transfer bus	4Q

| **Subproject 04 - Roof Reconstruction - Protection of Real Property, LLNL, Livermore, California**

TEC	Previous	FY 1998	FY 1999	FY 2000	FY 2001	Outyears	Construction Start - Completion Dates
$7,810	$ 3,000	$ 4,810	$ 0	$ 0	$ 0	$ 0	2Q FY 1998 - 2Q FY 1999

| This project received its final funding in FY 1998. No additional funding is required.

| **Project Milestones:**

| FY 1999: Complete construction 2Q

| **Subproject 05 - Storm Drain, Sanitary Sewer, and Domestic Water Systems, Modernization, SNL, Albuquerque, New Mexico**

TEC	Previous	FY 1998	FY 1999	FY 2000	FY 2001	Outyears	Construction Start - Completion Dates
$15,374	$ 0	$ 1,483	$ 7,326	$ 665	$ 0	$ 5,900	1Q 1999 - 4Q 2003

| Much of the storm drain system, sanitary sewer system, and water distribution system at SNL have been in place for 30 to 50 years. Studies and video inspection have shown that the systems are in need of rehabilitation and expansion. As time passes, utilities that support DOE programs will be threatened, and the probability of losses of equipment and time will increase. Systems in deteriorated condition have high maintenance costs.

| This subproject at SNL will: (1) rehabilitate and enlarge the storm drain system to reduce the risk of flooding of existing facilities, reduce or eliminate risks of soil and groundwater contamination, and minimize maintenance costs caused by the erosion of unlined channels; (2) rehabilitate the sanitary sewer system to address the issues of old, deteriorating sewer lines, and the threat of contamination of soil and water due to leakage by rehabilitating sewer lines and manholes; and (3) improve the water distribution system and fire protection by tying into the new Kirtland Air Force Base (KAFB) lines, improving electronic controls, installing water meters, and replacing several deteriorated water lines.

One of Sandia's environmental missions is to be in full compliance with the Federal environmental regulations, including all appropriate permitting. Regulatory drivers for this subproject include the Safe Drinking Water Act, National Pollutant Discharge Elimination System, 40 CFR 122, 123, and 124, the
| Clean Water Act, DOE Order 6430.1A, and Tiger Team Finding SW/CF-04.

Storm Drain System

| Comprehensive drainage system analyses have been completed for SNL. These system analyses showed that six facilities in Technical Areas I, II, and IV would be impacted by the 100-year floodplain, including Building 880, which houses several Cray mainframe computers, key to a number of programs. Eight facilities in Technical Areas III and V would be impacted by the 100-year floodplain. Improvement to and expansion of the storm drain system as described below would remove the facilities in Technical Areas I, II, III, IV, and V from the 100-year floodplain.

Camera equipment was used to inspect the storm drain lines in 1992 and showed that approximately 26,524 feet of storm drain systems require major repair or replacement to alleviate flooding and structural failure. The majority of the failing system is in Technical Area I and has exceeded its 40-year design life.

A sedimentation and capacity analysis performed for existing earth-lined channels determined that existing utilities adjacent to the channels are at risk to damage due to erosion of the channel flow. The results show that no matter how well the channels are maintained, failure is imminent. Failure will lead to roads being washed out leading to Technical Area IV, overtopping of the channel, and possibly flooding of facilities. This project proposes to line the existing channels with concrete to prevent erosion, increase capacity, protect utilities, and reduce the amount of sediment carried downstream.

The following improvements will be made to the Storm Drain System:

- Enlarge the 9th Street and 17th Street storm drains to accommodate the 100-year developed-conditions runoff, including the diversion of flows from the 14th Street and G Street intersection.
- Line the 9th Street, 14th Street, 17th Street, and a portion of the 20th Street channels to eliminate erosion and minimize sediment transport.
- Install a storm-drain pipe in the 20th Street channel from Harding Blvd. to G Street.
- Construct berms, channels, and inlets and upsize culverts in Technical Areas III and V.
- Further integrate streets and storm inlets to ensure that storm flows can reach the storm sewer systems.
- Replace deteriorated storm drain inlets and manholes.

Sanitary Sewer System

A condition assessment report for the sewer system was completed in 1992 using in-line camera inspection data. The report was updated in 1995. The report categorized 25 percent of the sanitary sewer lines in Technical Areas I, II, and IV, and 164 sewer manholes as in either "poor" or "fair" condition. This means that several miles of pipe have a high probability of leaking industrial wastewater into the surrounding soil through cracks, separated joints, and corroded pipes. The worst section of pipe are also in danger of collapsing and backing wastewater up into buildings, many of which are critical to the mission of SNL. The proposed project will mitigate the poor condition of the system.

The following improvements will be made to the Sanitary Sewer System:

- Rehabilitate approximately 22,000 linear feet of the existing, deteriorated system using u-liner, slip lining, and open cut methods.
- Repair approximately 100 sewer manholes that are in "fair" or "poor" condition.

Water Distribution System

Under National Fire Protection Association codes, redundant water supply is required for fire protection. An important part of this project is to improve fire protection by providing a redundant water supply and a properly grided system. Kirtland Air Force Base (KAFB) is installing a new supply and distribution system. This project makes several ties to the SNL system to improve water distribution and fire protection in Technical Areas I, II, and IV.

The existing water distribution system does not have electronic storage-tank monitoring devices needed to monitor the system properly. SNL is responsible via an interagency agreement with the Air Force for the operation and maintenance of the water system within SNL boundaries. With basic electronic monitoring, SNL will be able to monitor the system with confidence.

SNL is currently unable to monitor water consumption. As part of a Memorandum of Understanding with Federal and state agencies, SNL has agreed to cooperate in a water conservation effort. This project will provide meters at tie-in points to the KAFB system and will provide consumption data. This data will be used as part of a water conservation effort.

The following improvements will be made to the water distribution system:

- Install electronic monitoring equipment on the system.
- Install water meters at connections between Sandia and KAFB.
- Rehabilitate or replace deteriorated water lines.

Project Milestones:

FY 1999:	Complete Title II Design for the Storm Drains	2Q
	Start Construction on the Storm Drains	2Q
	Start Construction on the Water System Meters and Controls	2Q
	Complete Construction on the Sanitary Sewers	4Q
	Complete Construction on the Water System Meters and Controls	4Q
FY 2000:	Complete 9th Street Storm Drain System	3Q

Subproject 06 - Site 300 Fire Station/Medical Facility, LLNL, Livermore, California

TEC	Previous	FY 1998	FY 1999	FY 2000	FY 2001	Outyears	Construction Start - Completion Dates
$ 5,350	$ 0	$ 900	$ 4,450	$ 0	$ 0	$ 0	3Q 1999 - 4Q 2000

This project received its final funding in FY 1999. No additional funding is required.

Project Milestones:

FY 1999:	Complete Title II Design	1Q
	Start Construction	3Q
FY 2000:	Complete Construction	4Q

4. Details of Cost Estimate

	(dollars in thousands) Current Estimate	Previous Estimate
Design Phase		
Preliminary and Final Design costs (Design Drawings and Specifications)	5,232	4,580
Design Management Costs (1.4% of TEC)	1,041	939
Project Management Costs (0.9% of TEC)	635	524
Total Design Costs (9.3% of TEC)	6,908	6,043
Construction Phase		
Improvements to Land	11,335	11,335
Buildings	8,616	8,616
Special Equipment	8,235	8,235
Other Structures	7,452	7,452
Utilities	14,219	13,847
Standard Equipment	200	200
Removal Cost Less Salvage	704	704
Inspection, Design and Project Liaison, Testing, Checkout and Acceptance	2,906	2,918
Construction Management (2.9% of TEC)	2,175	1,991
Project Management (2.1% of TEC)	1,522	1,384
Total Construction Costs (77.3% of TEC)	57,364	56,682
Contingencies		
Design Phase (1.5% of TEC)	1,122	1,206
Construction Phase (11.9% of TEC)	8,832	10,295
Total Contingencies (13.4% of TEC)	9,954	11,501
Total, Line Item Costs (TEC) [d]	74,226	74,226

5. Method of Performance

Design and procurement of the conventional facilities will be performed under negotiated architect-engineer contracts. To the extent feasible, construction and procurement will be accomplished by fixed-price contracts and subcontracts awarded on the basis of competitive bidding.

[d] Rates used for escalation were taken from applicable DOE Departmental Price Change Indices, applied to the mid-point of the construction schedule.

6. Schedule of Project Funding

(dollars in thousands)

	Prior Years	FY 1998	FY 1999	FY 2000	FY 2001	Outyears	Total
Total project costs							
Total facility costs							
Design	2,787	2,270	2,148	540	285	0	8,030
Construction	1,297	19,200	26,531	12,262	1,006	5,900	66,196
Total facility costs (Federal and Non-Federal)	4,084	21,470	28,679	12,802	1,291	5,900	74,226
Other project costs							
Conceptual design cost	1,072	0	0	0	0	0	1,072
Decontamination and Decommissioning (D&D)	10	0	0	0	0	0	10
NEPA documentation costs	124	0	0	0	0	0	124
Other ES&H costs	50	10	25	15	0	15	115
Other project-related costs	360	98	118	55	10	110	751
Total other project costs	1,616	108	143	70	10	125	2,072
Total Project Cost (TPC)	5,700	21,578	28,822	12,872	1,301	6,025	76,298

7. Related Annual Funding Requirements

(FY 2003 dollars in thousands)

	Current Estimate	Previous Estimate
Related annual costs (estimated life of project--40 years)		
Facility operating costs	155	100
Facility maintenance and repair costs	208	208
Programmatic operating expenses directly related to the facility	660	660
Capital equipment not related to construction but related to the programmatic effort in the facility	0	50
GPP or other construction related to the programmatic effort in the facility	50	0
Utility costs	0	56
Other costs	1	0
Total related annual costs (operating from FY 2003 through FY 2042)	1,074	1,074

96-D-104, Processing and Environmental Technology Laboratory, Sandia National Laboratories, Albuquerque, New Mexico

(Changes from FY 1999 Congressional Budget Request are denoted with a vertical line [|] in the left margin.)

Significant Changes

None.

1. Construction Schedule History

	Fiscal Quarter				Total Estimated Cost ($000)	Total Project Cost ($000)
	A-E Work Initiated	A-E Work Completed	Physical Construction Start	Physical Construction Complete		
FY 1996 Budget Request *(Preliminary Estimate)*	2Q 1996	4Q 1997	1Q 1997	1Q 1999	45,900	48,600
FY 1997 Budget Request	2Q 1996	4Q 1997	1Q 1997	1Q 1999	45,900	49,000
FY 1998 Budget Request	2Q 1996	4Q 1997	1Q 1998	1Q 1999	45,900	49,000
FY 1999 Budget Request *(Title I and II Baseline)*	2Q 1996	4Q 1997	2Q 1998	4Q 2000	45,900	47,190
FY 2000 Budget Request *(Current Baseline Estimate)*	2Q 1996	4Q 1997	2Q 1998	4Q 2000	45,900	47,082

2. Financial Schedule

(dollars in thousands)

Fiscal Year	Appropriations	Obligations	Costs
Design/Construction			
1996	1,980 [a]	1,980	893
1997	14,100	14,100	2,859
1998	0	0	5,029
1999	18,920	18,920	16,593
2000	10,900	10,900	20,455
2001	0	0	71

[a] Includes appropriation of $1,800,000 plus an internal reprogramming of $180,000 that was provided to allow management efficiencies achievable through coordination of engineering and design contracts.

3. Project Description, Justification and Scope

The Processing and Environmental Technology Laboratory (PETL) is a new laboratory/office facility to be located on a presently vacant site. The proposed building is a three-story building with a partial basement. The building will contain approximately 151,435 gross square feet with a total net square feet of 79,163. The Office/Laboratory consists of two primary functional areas, laboratory and office space. The offices are located at the perimeter of the facility, and the laboratories are in the center, and the service area is located at the west end. The building is designed to meet the latest ES&H requirements for facilities of this type. Vibration isolation, pedestrian circulation, emergency egress, separation between laboratory and technician work stations, and separate laboratory service corridors which serve as secondary emergency exits are all design responses to identified user requirements. The building will have a modular design to facilitate varying the size of laboratory and office spaces in minimum time and at low costs, as user requirements change. The building is oriented on an east-west axis to achieve maximum opportunity for solar gain along the south elevations.

Generally, interior walls are gypsum board over metal studs. Appropriate fire separation barriers will be provided as required by the Life Safety Code and the DOE order for fire protection. The structural system will consist of steel and/or concrete framing as required to meet the users' vibration criteria for sensitive equipment. Laboratory floor systems will likely be constructed with waffle or pan joist framing. The exterior finish of the building will be a low maintenance product that is designed to integrate with the existing campus architecture.

The heating, ventilating, and air conditioning systems include a double duct, variable air volume (VAV), perimeter heating/cooling system, and a core or interior single duct VAV system. Heating will be provided by piped hot water generated by a gas-fired boiler. A large thermal storage water tank filled with chilled water from existing chillers in Building 858 will provide cold water for building cooling and test equipment. Interior plumbing systems will include sanitary waste, domestic hot and cold water, compressed air, natural gas, and chilled water supply and return. Exhaust will be provided by utility fans located at the roof level, connected to exhaust duct risers in chases. Site utilities include a primary electric feeder, signal duct, water, natural gas, and sanitary sewer. Area improvements will include security fencing, storm drain inlets, and service and driveway areas. Landscaping, including trees, shrubs, irrigation systems and gravel, will be provided consistent with existing landscape practices.

The PETL is an important element that will enable the Department of Energy (DOE) Stockpile Stewardship and Management program to use an aggressive R&D program to develop production processes which will offer significant cost reductions and minimize the use of toxic materials. The synergism represented by PETL meets the DOE's objective in that it collocates individuals responsible for identifying and developing new materials and processes with those translating them to application.

The focus of PETL is the development, characterization, and application of modern processing while at the same time ensuring the safety of the environment and personnel, and producing products required for nuclear weapons applications. PETL allows the integration of real-time, on-line diagnostics, and test structures in processing lines for "self-identification" of processing problems. The substitution of environmentally safer processing chemicals will be analyzed to minimize design impact and to assess the affect on long-term compatibility. Analytical support for production of non-nuclear components will replace services provided by integrated complex plants, as the manufacturing complex is reduced in size and Manufacturing Development Engineering (MDE) increases.

Because DOE is faced with developing a more efficient complex to produce and to dismantle weapons, as well as to address ES&H issues affecting operations and nuclear weapon production, additional space is needed for efforts involving materials compatibility, aging, and reliability. These efforts are essential in certifying the reliability of the nuclear weapons stockpile.

PETL occupants will include: the Materials and Process Sciences Center, the Engineered Materials and Processes Center, and parts of the Environment Center and the Microelectronics Center. It will provide facilities for staff seeking timely solutions to the following critical problems:

- Assuring safety and reliability of a smaller stockpile incorporating new materials and processes for production.
- Elimination of some materials from nuclear weapons because of production/usage restrictions, or total bans, and increased requirements to minimize occupational exposure with minimum effect on the reliability of nuclear weapons.
- Substitution of environmentally safer materials and processes during nuclear weapon production, with minimum effect on the reliability of nuclear weapons.
- Elimination/reduction of hazardous waste (radioactive, mixed, or chemically hazardous) during nuclear weapon production and better treatment (including detoxification or stabilization) of newly generated hazardous wastes.
- Dismantling nuclear weapons in an environmentally acceptable and safe manner.
- Compliance by SNL and the Nuclear Weapons Complex with ES&H laws, regulations, DOE orders, and industry standards.

Currently, materials activities are divided among nine different buildings. PETL will allow these activities to be centralized into one facility. Because most of the current laboratories are located in old facilities, the move to PETL will assist in conforming to current and expected regulations, DOE orders, and best industry ES&H practices. The new building is designed to conduct environmentally and occupationally safe R&D involving hazardous materials used in weapon production.

Removal Plan:

The following buildings will be vacated by organizations proposing to move to the PETL:

Building	Year Acquired	Building Size (Net Square Feet)	Space Vacated (Net Square Feet)	Organization(s)
805	1959	48,471	40,923	1800
806	1961	39,640	8,565	1800
807	1966	52,845	3,561	1800
823	1982	79,667	3,503	6600
828	1946	11,475	1,064	1800
894	1950	75,514	302	1800
T-47	1979	3,273	1,356	1800
897	1995	81,534	3,000	1800
858	1985	71,648	5,437	1300
Total			67,711	

Building 828 is considered substandard and included in the SNL substandard and temporary abandoned building decontamination and disposal program under a separate, future expense-funded project. It is expected the other space vacated by future PETL occupants will be backfilled by technical and administrative organizations as part of the Lab-wide space planning strategy.

| **Project Milestones:**

| FY 1999:	Complete site construction (Chilled Water Tank)	2Q
| FY 2000:	Equipment procurement	3Q
|	Occupy building	3Q
|	Complete building construction	4Q

4. Details of Cost Estimate

	(dollars in thousands) Current Estimate	Previous Estimate
Design Phase		
Preliminary and Final Design costs (Design Drawings and Specifications - $1,761)	3,254	3,254
Design Management Costs (1.2% of TEC)	556	556
Project Management Costs (0.7% of TEC)	323	323
Total Design Costs (9.0% of TEC)	4,133	4,133
Construction Phase		
Buildings	28,930	28,930
Special Equipment	4,897	4,897
Standard Equipment	1,295	1,295
Inspection, Design and Project Liaison, Testing, Checkout and Acceptance	1,611	1,611
Construction Management (0.7% of TEC)	324	324
Project Management (0.9% of TEC)	406	406
Total Construction Costs (81.6% of TEC)	37,463	37,463
Contingencies		
Construction Phase (9.4% of TEC)	4,304	4,304
Total Contingencies (9.4% of TEC)	4,304	4,304
Total, Line Item Costs (TEC) [b]	45,900	45,900

5. Method of Performance

Design and inspection shall be performed under a negotiated architect-engineering contract. Construction and procurement shall be accomplished by fixed-price contracts awarded on the basis of competitive bidding.

[b] Escalation rates taken from the FY 1996 DOE escalation multiplier tables.

6. Schedule of Project Funding

(dollars in thousands)

	Prior Years	FY 1998	FY 1999	FY 2000	FY 2001	Outyears	Total
Total project costs							
Total facility costs							
Design	3,724	409	0	0	0	0	4,133
Construction	28	4,620	16,593	20,455	71	0	41,767
Total facility costs (Federal and Non-Federal)	3,752	5,029	16,593	20,455	71	0	45,900
Other project costs							
Conceptual design costs	220	0	0	0	0	0	220
NEPA documentation costs	90	0	0	0	0	0	90
Other ES&H costs	29	0	0	0	0	0	29
Other project-related costs [c]	801	12	15	15	0	0	843
Total other project costs	1,140	12	15	15	0	0	1,182
Total Project Cost (TPC)	4,892	5,041	16,608	20,470	71	0	47,082

7. Related Annual Funding Requirements

(FY 2001 dollars in thousands)

	Current Estimate	Previous Estimate
Related annual costs (estimated life of project--50 years)		
Facility operating costs	631	631
Facility maintenance and repair costs	312	312
Programmatic operating expenses directly related to the facility [d]	45,903	45,903
Capital equipment not related to construction but related to the programmatic effort in the facility [e]	1,800	1,800
Utility costs [f]	610	610
Total related annual costs (operating from FY 2001 through 2050)	49,256	49,256

[c] Includes in-house engineering support, project development and project management costs prior to authorization, and non-dedicated support activities throughout this project life.

[d] Programmatic operating expenses directly related to the facility include salaries and supplies for approximately 200 people estimated at $229,518 per person per year.

[e] Capital equipment not related to construction but related to the programmatic effort in the facility is estimated using historical data associated with the annual replacement of worn-out analytical equipment.

[f] Utility costs were estimated using the gas and electric consumption rates from the Title II Energy Conservation Report and water use data from other typical office/laboratory facilities at SNL/NM.

96-D-111, National Ignition Facility (NIF), Lawrence Livermore National Laboratory, Livermore, California

(Changes from FY 1999 Congressional Budget Request are denoted with a vertical line [|] in the left margin.)

Significant Changes

None.

1. Construction Schedule History

	Fiscal Quarter				Total Estimated Cost ($000)	Total Project Cost ($000)
	A-E Work Initiated	A-E Work Completed	Physical Construction Start	Physical Construction Complete		
FY 1996 Budget Request (*Preliminary Estimate*)	1Q 1996	1Q 1998	3Q 1997	3Q 2002	842,600	1,073,600
FY 1998 Budget Request (*Title I Baseline*)	1Q 1996	1Q 1998	3Q 1997	3Q 2003	1,045,700	1,198,900
FY 1999 Budget Request	1Q 1996	2Q 1998	3Q 1997	3Q 2003	1,045,700	1,198,900
FY 2000 Budget Request *(Current Baseline Estimate*)	1Q 1996	2Q 1998	3Q 1997	3Q 2003	1,045,700	1,198,900

2. Financial Schedule

(dollars in thousands)

Fiscal Year	Appropriations	Obligations	Costs
Design/Construction			
1996	37,400	37,400	33,990
1997	131,900	131,900	74,294
1998	197,800	197,800	165,389
1999	284,200	284,200	248,367
2000	248,100	248,100	214,440
2001	74,100	74,100	181,200
2002	65,000	65,000	110,680
2003	7,200	7,200	17,340

3. Project Description, Justification and Scope

The Project provides for the design, procurement, construction, assembly, installation, and acceptance testing of the National Ignition Facility (NIF), an experimental inertial confinement fusion facility intended to achieve controlled thermonuclear fusion in the laboratory by imploding a small capsule containing a mixture of the hydrogen isotopes, deuterium and tritium. The NIF is being constructed at the Lawrence Livermore National Laboratory (LLNL), Livermore, California as determined by the Record of Decision made on December 19, 1996, as a part of the Stockpile Stewardship and Management Programmatic Environmental Impact Statement (SSM PEIS).

The mission of the National Inertial Confinement Fusion (ICF) program is to achieve controlled thermonuclear fusion in the laboratory. This program supports the DOE mandate of maintaining nuclear weapons science expertise required for stewardship of the stockpile, testing of nuclear weapons effects, and the development of fusion power by providing a database for inertial fusion ignition. As a key element of the Stockpile Stewardship Program, the NIF is designed to achieve propagating fusion burn and modest (1-10) energy gain within 2-3 years of full operation and to conduct high energy density experiments, both through fusion ignitions and through direct application of the high laser power. This mission was identified in the NIF Justification of Mission Need, which was endorsed by the Secretary of Energy. Identification of target ignition as the next important step in ICF development for both defense and non-defense applications is consistent with the earlier (1990) recommendation of DOE's Fusion Policy Advisory Committee, and the National Academy of Sciences Inertial Fusion Review Group. In 1995, the DOE's Inertial Confinement Fusion Advisory Committee affirmed the program's readiness for an ignition experiment. A review by the JASONs in 1996 affirmed the value of the NIF for stockpile stewardship.

The NIF project supports the DOE mandate to maintain nuclear weapons science expertise required for stewardship of the stockpile. After the United States announcement of a moratorium on underground nuclear tests in 1992, the Department established the Stockpile Stewardship program to ensure the preservation of the core intellectual and technical competencies in nuclear weapons. In addition, as a means of reducing the danger posed by nuclear weapons proliferation, the President announced that the United States would seek a zero yield Comprehensive Test Ban Treaty (CTBT). The treaty was signed on September 24, 1996, and submitted to the Senate for ratification on September 23, 1997. One of the six safeguards that defines the terms of the CTBT is the conduct of the Stockpile Stewardship program to ensure the safety and reliability of the stockpile. The NIF is one of the most vital facilities in that program. The NIF will provide the capability to conduct laboratory experiments to address the high energy density and fusion aspects that are so important to both primaries and secondaries in stockpile weapons.

At present, the Nation's computational capabilities and scientific knowledge are inadequate to ascertain all of the performance and safety impacts from changes in the nuclear warhead physics packages due to aging, remanufacturing, or engineering and design alterations. Such changes are inevitable if the warheads in the stockpile are retained well into the next century, as expected. In the past, the impacts of such changes were evaluated through nuclear weapon tests. Without underground tests, we will require better, more accurate computational capabilities to assure the reliability and safety of the nuclear weapons stockpile for the indefinite future.

To achieve the required level of confidence in our predictive capability, it is essential that we have access to near-weapons conditions in laboratory experiments. The importance of nuclear weapons to our national security requires such confidence. For detonation of weapon primaries, that access is provided in part by hydrodynamic testing. For secondaries and for some aspects of primary performance, the NIF will be a principal laboratory experimental physics facility.

The most significant potential commercial application of ICF in the long term is the generation of electric power. Consistent with the recommendations of the Fusion Policy Advisory Committee, the NIF will provide a unique capability to address critical elements of the inertial fusion energy program by exploring moderate gain (1 to 10) target designs, establishing requirements for driver energy and target illumination for high gain targets, and developing materials and technologies useful for civilian inertial fusion power reactors.

The ignition of an inertial fusion capsule in the laboratory will produce extremely high temperatures and densities in matter. Thus, the NIF will also become a unique and valuable laboratory for experiments relevant to a number of areas of basic science and technology.

The NIF is an experimental fusion facility consisting of a laser and target area, and associated assembly and refurbishment capability. The laser will be capable of providing an output pulse with an energy of 1.8 megajoules (MJ) and an output pulse power of 500 terawatts (TW) at a wavelength of 0.35 micrometers (µm) and with specified symmetry, beam balance and pulse shape. The NIF design provides an experimental facility to house a multibeam line, neodymium (Nd) glass laser capable of generating and delivering the pulses to a target chamber. In the target chamber, a positioner will center a target containing fusion fuel, a deuterium-tritium mixture, for each experiment. Diagnostics provided by this project will provide the test data to demonstrate subsystem performance and initial operations.

The NIF experimental facility, titled the Laser and Target Area Building, will provide an optically stable and clean environment. This laser building will be shielded for radiation confinement around the target chamber and will be designed as a radiological, low-hazard facility capable of withstanding the natural phenomena specified for the LLNL site. The baseline facility is for one target chamber, but the design shall not preclude future upgrade for additional target chambers.

The NIF project consists of conventional and special facilities.

- Site and Conventional Facilities include the land improvements (e.g., grading, roads) and utilities (electricity, heating gas, water), as well as the laser building, which has an approximately 20,300 square meters footprint and 38,000 square meters in total area. It is a reinforced concrete and structural steel building that provides the vibration-free, shielded, and clean space for the installation of the laser, target area, and integrated control system. The laser building consists of two laser bays, each 31 meters (m) by 135 m long, and a central target area--a heavily shielded (1.8 m thick concrete) cylinder 32 m in diameter and 32 m high. The laser building includes security systems, radioactive confinement and shielding, control rooms, supporting utilities, fire protection, monitoring, and decontamination and waste handling areas. Optics assembly and refurbishment capability is provided for at LLNL by incorporation of an optics assembly area attached to the laser building and minor modifications of other existing site facilities.

- Special facilities include the Laser System, Target Area, Integrated Computer Control System, and Optics.

  - The laser system is designed to generate and deliver high power optical pulses to the target chamber. The system consists of 192 laser beamlets configured to illuminate the target surface with a specified symmetry, uniformity, and temporal pulse shape. The laser pulse originates in the pulse generation system. This precisely formatted low energy pulse is amplified in the main amplifier. To minimize intensity fluctuation, each beam is passed through a pinhole in a spatial filter on each of the four passes through the amplifier and through a transport spatial filter. The beam transport directs each high power laser beam to an array of ports distributed around the target chamber where the frequency of the laser light is tripled to 0.35 µm, spatially modulated by phase plates and focused on the target. Systems are provided for automatic control of alignment and the measurement of the power and energy of the beam. Structural support and auxiliary systems provide the stable platform and utilities required.

  - The target area includes a 10 m diameter, low activation (i.e., activated from radiation) aluminum vacuum chamber located in the Target Area of the laser building. Within this chamber, the target will be precisely located. The chamber and building structure provide confinement of radioactivity (e.g., x-rays, neutrons, tritium, and activation products). Diagnostics will be arranged around the chamber to demonstrate subsystem performance for project acceptance (TEC) and initial operations (TPC). Structural, utility and other support systems necessary for safe operation and maintenance will also be provided in the Target Area. The target chamber and staging areas will be capable of conducting experiments with cryogenic targets. The Experimental Plan indicates that cryogenic target experiments for ignition will be needed 2-3 years after completion of the project. Therefore, the targets and this cryogenic capability will be supplied by the experiments. The NIF project will make mechanical and electrical provisions necessary to position and align the cryogenic targets within the chamber. The baseline is for indirectly driven targets. An option for future modifications to permit directly driven targets is included in the design.

  - The integrated computer control system includes the computer systems (note: no individual computer will cost over $100,000) required to control the laser and target systems. The system will provide the hardware and software necessary to support NIF operations. Also included is an integrated timing system for experimental control of laser and diagnostic operations. Safety interlocks and access control will also be provided.

  - Thousands of optical components will be required for the 192 beamlet NIF. These components include laser glass, lenses, mirrors, polarizers, deuterated potassium dihydrogen phosphate crystals, pulse generation optics, debris shields and windows, and the required optics coatings. Optics includes quality control equipment to receive, inspect, characterize, and refurbish the optical elements.

| **Project Milestones:**

| Project milestones for FY 1999 and FY 2000 include:

| # FY 1999

- | ‣ Special Equipment Installation Started — 1Q
- | ‣ Target Bay ready for Target Chamber Installation — 2Q
- | ‣ Optics Assembly Building Complete (certified cleanrooms) — 4Q

| # FY 2000

- | ‣ Switchyard #2 Steel Structures Complete — 1Q
- | ‣ Optics Facilitization Complete — 1Q
- | ‣ Conventional Construction Complete and following will be commissioned for installation of
  | Special Equipment:
  - | S Switchyard #2 — 3Q
  - | S Laser Bay #2 — 4Q
  - | S Target Bay — 4Q

4. Details of Cost Estimate

	(dollars in thousands)	
	Current Estimate	Previous Estimate
Design Phase		
Preliminary and Final Design costs (Design Drawings and Specifications)	101,143	76,883
Design Management Costs (2.1% of TEC)	21,900	18,387
Project Management Costs (2.1% of TEC)	22,000	15,100
Total Design Costs (13.9% of TEC)	145,043	110,370
Construction Phase		
Improvements to Land	1,800	1,800
Buildings	170,724	159,280
Special Equipment	520,802	515,700
Utilities	500	500
Inspection, Design and Project Liaison, Testing, Checkout and Acceptance	73,250	73,250
Construction Management (2.2% of TEC)	22,800	21,500
Project Management (3.0% of TEC)	31,500	31,500
Total Construction Costs (78.5% of TEC)	821,376	803,530
Contingencies		
Design Phase (0.0% of TEC)	1,000	11,800
Construction Phase (7.5% of TEC)	78,281	120,000
Total Contingencies (7.6% of TEC)	79,281	131,800
Total, Line Item Costs (TEC) [a b]	1,045,700	1,045,700

The cost estimate assumes a project organization and cost distribution consistent with the management requirements appropriate for a DOE Strategic System as outlined in the DOE Order 430.1, Life Cycle Asset Management and the NIF Project Execution Plan. Actual cost distribution will be in conformance with accounting guidelines in place at the time of project execution.

[a] Escalation rates taken from the FY 1998 DOE escalation multiplier tables.

[b] Based on completion of Title II design for Conventional Facilities and 89 percent of Title II design for Special Equipment as of December 1998.

5. Method of Performance

The NIF Laboratory Project Office (consisting of LLNL, LANL, SNL, and UR/LLE and supported by competitively-selected contracts with Architect Engineering firms, a Construction Manager, equipment and material vendors, and construction firms) will prepare the design, procure equipment and materials, and perform conventional construction, safety, system analysis, and acceptance tests. DOE will maintain oversight and coordination through the Headquarters Office of Inertial Fusion and the National Ignition Facility Project and the field office. DOE conducted the site selection and the NEPA determination. LLNL was selected as the construction site in the Record of Decision made on December 19, 1996. The procurement and installation/test of special equipment will be performed by the NIF Laboratory Project Office. Inspection and Title III engineering contracts for the conventional systems will be competitively awarded. NIF start-up will be conducted by the NIF laboratory operations staff.

6. Schedule of Project Funding

(dollars in thousands)

	Prior Years	FY 1998	FY 1999	FY 2000	FY 2001	Outyears	Total
Total project costs [c]							
Total facility costs							
Design	96,199	46,844	2,750	250	0	0	146,043
Construction	12,085	118,545	245,617	214,190	181,200	128,020	899,657
Total facility costs (Federal and Non-Federal)	108,284	165,389	248,367	214,440	181,200	128,020	1,045,700
Other project costs							
R&D necessary to complete construction [d]	34,552	50,574	14,234	1,940	0	0	101,300
Conceptual design cost [e]	12,300	0	0	0	0	0	12,300
NEPA documentation costs [f]	3,166	588	846	300	150	0	5,050
Other project-related costs [g]	16,385	2,430	2,235	5,050	6,120	2,330	34,550
Total other project costs	66,403	53,592	17,315	7,290	6,270	2,330	153,200
Total Project Cost (TPC)	174,687	218,981	265,682	221,730	187,470	130,350	1,198,900
Budget Authority (BA) requirements							
TEC [h]	169,300	197,800	284,200	248,100	74,100	72,200	1,045,700
OPC [i]	101,000	31,300	6,800	5,900	5,900	2,300	153,200
Total, BA requirements	270,300	229,100	291,000	254,000	80,000	74,500	1,198,900

[c] Prior year actuals are changed to reconcile with DOE Financial Information System (FIS) costs through FY 1998 and cost profiles for FY 1999 and beyond are updated to reflect project-to-date actuals and contingency allocations as of December 10 ,1998.

[d] Costs include optics vendor facilitization ($73,600,000) and optics quality assurance ($27,700,000).

[e] Includes original conceptual design report completed in FY 1994 ($12,000,000) and the conceptual design activities for the optical assembly and refurbishment capability and site infrastructure ($300,000).

[f] Includes preparation of the NIF portion of the Stockpile Stewardship and Management Programmatic Environmental Impact Statement ($3,050,000) and environmental monitoring and permits ($2,000,000).

[g] Includes engineering studies (including advanced conceptual design) of project options ($5,800,000); assurances, safety analysis, and integration ($9,450,000); start-up planning, management, training and staffing ($8,930,000); procedure preparation ($1,000,000); operating spares ($600,000); startup ($6,550,000); and Operational Readiness Review ($2,220,000).

[h] Specific long-lead procurements and contracts (e.g., building construction; major laser, optics, target area special equipment) require BA in advance of costs.

[i] Specific long-lead procurements and contracts (e.g., optics facilitization) require BA in advance of costs.

7. Related Annual Funding Requirements

	(dollars in thousands)	
	Current Estimate	Previous Estimate
Related annual costs (estimated life of project--30 years)		
Facility operating costs [j]	21,200	20,600
Facility maintenance and repair costs [k]	33,200	32,400
Programmatic operating expenses directly related to the facility [l]	61,100	59,600
Capital equipment not related to construction but related to the programmatic effort in the facility [m]	200	200
GPP or other construction related to the programmatic effort in the facility [n]	200	200
Utility costs [o]	9,000	8,800
Other costs [p]	6,300	6,200
Total related annual costs (operating from FY 2003 through FY 2032)	131,200 [q]	128,000 [r]

[j] Includes operator labor, engineering support and materials for upgrades and modifications, and consumables for operation of special equipment.

[k] Includes cost of labor, engineering support, and consumables for special equipment maintenance and refurbishment, including optics. Also includes maintenance for the laser building and support buildings.

[l] The current NOVA experimental program, including LLNL, LANL, SNL, and General Atomics, is approximately $41,100,000 annually. Based on use of complex cryogenic targets, increased diagnostics support, and higher levels of three dimensional physics modeling, the annual direct NIF experimental program costs are estimated at $61,100,000. This primary experimental operating expense will be included in the base Inertial Confinement Fusion Program budget. Additional program costs will be associated with use of the facility.

[m] Fabrication accounts, procurements, such as small lasers and some laser parts, Computer-Aided Design systems, etc. to support upgrades.

[n] Minor additions and modifications to the facility related to programmatic effort.

[o] Electricity only. Gas, sewer, water, etc. are paid out of the General and Administrative budget.

[p] Nitrogen and argon for laser and transport beam tubes, stock inventory, and procurement support.

[q] In FY 2000 dollars.

[r] In FY 1999 dollars.